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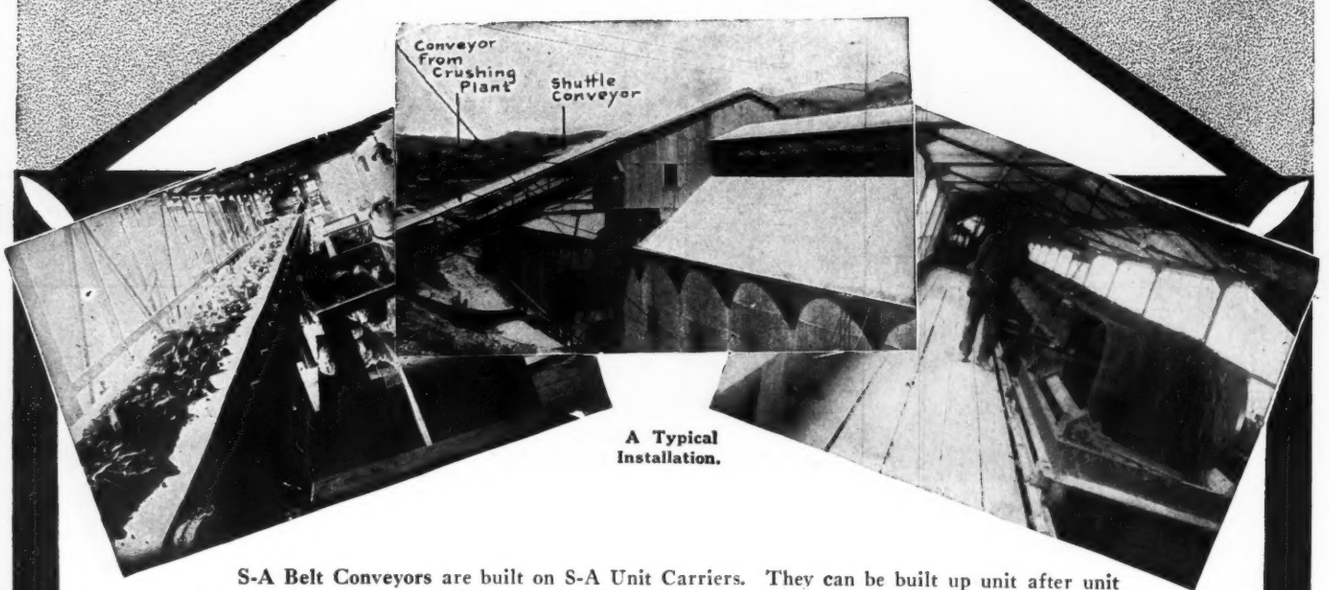

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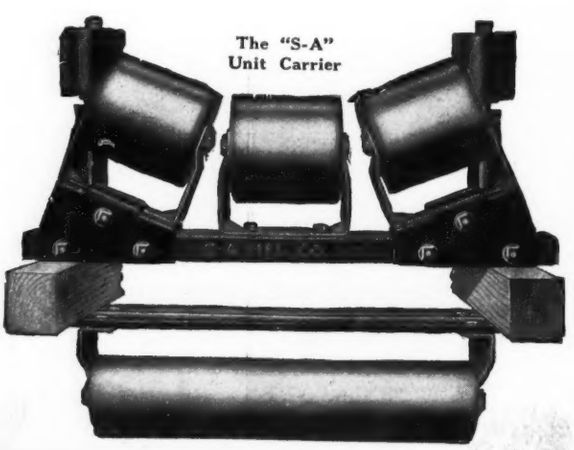

The "S-A" Unit Carrier

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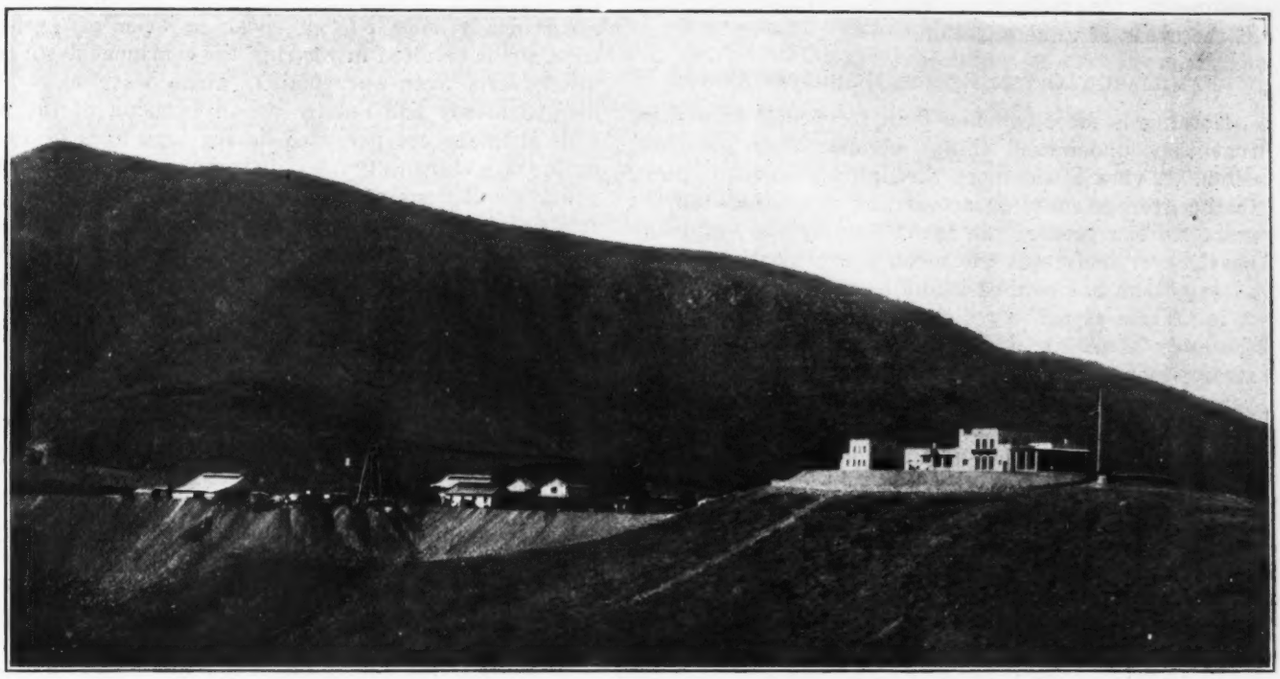

UNITED VERDE EXTENSION MINE. ON THE RIGHT IS THE HOME OF JAMES S. DOUGLAS

The Jerome District of Arizona—Part I

By J. R. FINLAY*

The geology of the district as disclosed by facts at present ascertainable, and conjectures that may be proposed to account for the formation and position of the ore deposits. Parallel instances in other districts are cited to add weight to the theories advanced. The history of two important Jerome mines—the United Verde and the United Verde Extension—is recorded, and interesting prophecies are made as to the probable results of future operations. The paper concludes with some pertinent remarks on the requisites for successful metal mine development.

JEROME is one of the most spectacular places in the United States. When an automobile road has been built direct from Prescott, it will be only 31 miles from that town. On that highway the tourist will come upon the Verde Valley first over the flank of Mount Mingus, and will find himself looking down over an escarpment 4500 ft. high. The picture will give him a thrill. Even after months of looking at it, much is found that has previously escaped notice. It is more than a scene of relief and color; it is a vast exposure of present-day geological processes, volcanoes, and erosion, and of important geological facts reaching back to the earliest recorded ages. By collating all these features, one finds that the panorama builds up an interest even exceeding that of the Grand Canyon. Fifteen or twenty miles away, straight in front across the valley, is the same great mass of colored strata that appears in the Canyon, but here forming only the front of the great plateau. On the summit, 60 miles away, are the San Francisco peaks, looking like Mount Shasta. In the bottom of the valley are glimpses of the river, amidst clouds of smoke from two great smeltery stacks, which, at this distance, look like pipestems.

In the discussion of this district, I am venturing to explore some of the dim realms of geological speculation which mining engineers usually avoid. I would have no desire to do this if there were not reason, more or less vague and hardly capable of clear expression, for thinking that these speculations follow a line which may lead to practical results.

No longer can there be any doubt that the study of ore

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deposits, from the point of view of pure science, has become part of the essential equipment of a mining man. Secondary enrichment, the magmatic origin of ore deposits, the effects of contact and regional metamorphism, the indications of such action in rock alteration, and many similar things are absorbed by hosts of men who have never consciously studied geology. It is far from impossible that a study of the history of earlier continental geography may lead to further knowledge of the areas of mineralization.

Familiarity Often Breeds Misunderstanding

Nothing is more common than for people to assume that they understand things because they see them often. A view of the moon through a good telescope is, to the average man, an astounding revelation—all the more so, the greater the man's intelligence—although nearly everybody sees the moon every month, and the average man has read of it and has a fair idea of what it is. There is nothing difficult about it. He may see the moon as plainly as he can see the house across the street: mountains and plains, bright sunlight and impenetrable shadow; lofty mountain pinnacles whose summits are aglow with the rising sun; a clear view of a sphere, not a flat disk—a huge object with an area greater than the United States and all its outliers. But did he realize it? He will probably have to confess that he did not. But, once he does, he will have no doubt that it is worth while, although the knowledge will never bring him a cent. Similarly, how many stop to realize that the unconformable parting of two rock formations is a record of great events and changes? That dividing plane is, at once, the surface of an ancient continent and the floor of an ancient sea. The fact is perfectly intelligible; it requires no extraordinary effort of the imagination. The only obstacle to overcome is the habit of not observing and thinking about such things.

Geologic Unconformities at Jerome

One of these unconformities is so conspicuous at Jerome that it serves as a starting point for the mining operations. The miners in half the district are exploring, not the present land surface, but the surface of a continent that was buried many millions of years ago. In a way, it is part of another world; not wholly inaccessible, like the moon, but probably less understood. Fragments of the pre-Cambrian surface are exposed at different places, but rarely more than its edges are brought to light. It is just as important to realize that this old surface may be destroyed by deep erosion, so that its most valuable and interesting features are lost, as it is to realize that the larger part of it is inaccessible because it is buried; more so, in fact, because there is a chance that part of the buried portion may be exhumed. In these tattered edges of the old continent are many valuable ore deposits—the iron mines of Michigan and Minnesota, the zinc mines of New Jersey, the old iron mines of Southeast Missouri, the gold mines of the Black Hills, and, no doubt, many others. Exploration, groping along this old surface, prompted by geological speculation, led to the discovery of the wonderful copper bonanza of the United Verde Extension. This single incident justifies a lot of speculation.

Of course, there is no profit in letting one's imagination run riot, creating pictures that are nothing but dreams. It is, however, possible to use the imagination as a searchlight to explore the dark world of possibility. In that way it may lead to many a solid fact.

Study of the mines of Jerome reveals a setting of impressive facts which point the way to some equally impressive conjectures. The facts are as follows:

1. The ore deposits were developed (geologically) into their present condition during the erosion of a continental area. This period of erosion continued for an exceptionally long period, speaking even of geologic time, for it resulted in wearing the continent down to a nearly level plain (peneplain), which was finally submerged slowly and quietly by an invasion of the sea. This submergence persisted during long ages of Palæozoic time with no greater disturbance than occasional gentle oscillations of level. The period of erosion had followed a period of mountain building which was, in all probability, exceptionally severe and widespread and was accompanied by volcanic or batholithic action on a grand scale. It appears, then, that the period of erosion, as well as the succeeding era of deposition during Palæozoic time, represents a long epoch of quiescence and extremely slow differential subsidence, following a period of disturbance during which the mountain-building forces in this part of the world had exhausted themselves.

2. The ore deposits are a part, or result, of almost the latest pre-Cambrian igneous action to be seen. The rock masses most intimately associated with them are not highly metamorphosed or disturbed; they are markedly less so than any of the older pre-Cambrian rocks which occur in the neighborhood.

3. Neither the ore deposits nor the rocks in which they occur differ in any essential respect (unless age is an essential) from deposits in nearby districts which were formed during the later mountain-building periods that brought to an end the long-continued submergence, sea invasion and marine deposition of Palæozoic, and again of Mesozoic, time.

4. The period of deposition which immediately preceded the pre-Cambrian continental uplift was an active and extensive one. It is represented by the Belt series of rocks, which are thick masses of sandstones or quartzites or conglomerates, shales and limestones—all prevailingly ripple-marked or sun-cracked, and containing some sparse remains of animal life thought to be chiefly fresh-water forms. At any rate, the evidence is positive that most of the Belt rocks were formed either on land surfaces or in shallow water, and were probably piled up in river deltas, playas, lakes, estuaries, and perhaps shallow arms of the sea or tide flats.

Characteristics of Belt Rocks

These Belt rocks were tilted, faulted, folded and metamorphosed during the latest great pre-Cambrian continental uplift, but they were not generally distorted or metamorphosed to anything like the extent to which still earlier rocks had been. In fact, they are found to lie upon them in positions of unconformity as abrupt as that which separates them from the succeeding Palæozoic rocks. Some of these still older rocks are also, without doubt, sedimentary; that is to say, they were once sands or muds. The separation between the Belt rocks and the still earlier ones therefore took place during a prior period of continental uplift, mountain

building, and erosion which had followed upon an even more primitive age of quiescence, subsidence and deposition.

The Belt rocks are thus so characteristic that they may be recognized with fair certainty wherever they are well exposed. They are found in large patches, some of them areas of thousands of square miles, extending from not far north of Roosevelt Dam, in Arizona, to central British Columbia, northwest of Banff—a distance of 1300 miles north and south, and within a strip about 300 miles wide east and west. Jerome is just west of the area in which these rocks are positively identified, lying about 100 miles northwest of large exposures described by Ransome in the Tonto Basin and about 75 miles slightly east of south of other large ones in the bottom of the Grand Canyon. About 200 miles northeast of the latter are large exposures in the Needle Mountains, in southwestern Colorado; 200 miles northwest of the Needle Mountains, across vast masses of later sediments, are found similar great exposures in the Wasatch Mountains of Utah; 75 miles further northwest, they occur along the Bear River, in Utah; and 225 miles further north begin the great areas of Belt rocks in western Montana, which extend thence far northwesterly through the Cœur d'Alene region of Idaho into British Columbia.

Deductions From Acknowledged Facts

I have recited these facts in order to show the broad basis for the following conjectures, which appear to me to be reasonable:

1. The Belt formation is the filling of a great epicontinental depression or trough which was either filled as fast as it sank or sank because it was filled, so that during the whole process its surface was fairly level and low. One cannot be sure, of course, that there were not two or several basins with interruptions between; but even if so, the conditions in all were substantially the same. This parallelism of conditions over so wide an area could have been induced only by a dominant influence sufficiently potent to dwarf local influences. It is noticeable that the Belt rocks contain stupendous quantities of fine sands, grading in fineness down to true silts, and alternating. Coarse pebbly sands, to say nothing of heavy conglomerates, are rare. It is, therefore, plain that these materials must have been transported far enough to break up effectually all the coarser products of erosion; but at the same time the detritus was delivered into the settling area constantly and in great volume.

It seems to me that such conditions of combined uniformity and volume over such extended areas must indicate the neighborhood of a great mountain chain, or at least an extensive belt of highlands on one side or both sides of the trough. It is not necessary to call upon a direct effort of imagination to find an explanation; the geography of the present day offers a number of examples from which to choose.

The great uplift of the Himalayas is bordered on both sides by similar areas of deposition. On the south side is the Ganges flood plain, covering 300,000 square miles, in which recent sediments borne by the Ganges and Brahmaputra are known to be over 2000 ft. deep and may continue to accumulate in the future almost without limit and without pronounced change in their character. The vast plains bordering the Sea of Aral are a similar field, being filled with detritus brought down by the Oxus and the Jaxartes, and with dust and sand swept in by desert winds.

Parallel Instances in North America

Or one may turn to North America to find several other examples; namely, the Gulf of California, the upper end of which has already been filled across by the detritus of the Colorado River, so that its northern extension has been cut off and the water there has evaporated, leaving a large area below sea level. This trough is 800 miles long, 100 to 150 miles wide and is receiving sands and silts of both rivers and winds from a vast area of erosion. The valley of California, 400 miles long and 75 miles wide, between the Sierra Nevada and the Coast Range, is being filled with detritus of the same nature, already known to be over 2000 ft. deep, and is sinking as it fills.

Still another example, on a scale and of a nature sufficient to make a parallel with the Belt rocks, is the great coastal plain of North America beginning at Long Island and extending along the coast through Georgia, Florida, Louisiana, and Texas into eastern Mexico—a distance along a gently curved line of fully 2000 miles, with a width up to 500 miles, and receiving the detritus of all the rivers on both sides of the Appalachian Mountains, and from the Rocky Mountain uplift for 2000 miles, from Tampico to Alberta. It receives the sands migrating down the Missouri and the Arkansas, the Rio Grande, the Nueces, the Guadalupe, the Brazos, the Red River, the Mississippi, the Ohio, the Alabama, the Flint, the Savannah, the Potomac, the Susquehanna, and the Hudson—513,000,000 tons a year of sand and mud, besides 270,000,000 tons of chemicals in solution. This whole coast is an interminable stretch of fine sands, assorted by waves and shore currents, piled up on the shore in dunes. This mass has been accumulating and slowly shifting without striking interruption since the beginning of Upper Cretaceous times, and no one knows how deep it is.

At any rate, the Belt rocks represent some such scale of grand continental features, great mountains and great rivers, debouching upon a huge subsiding basin or slope for ages under conditions generally as quiet and stable as those on our Gulf Coast today. In this great basin there was little volcanic activity. It is probable that there was some, but it certainly was hardly more prominent than it has been along the coastal plain—no greater than that in the valley of California in recent times.

Volcanic Activity Follows Period of Slight Action

When this cycle of deposition came to an end, however, there was an outburst of mountain-building energy on a great scale, accompanied by volcanic activity and batholithic action. Before this ended, the Belt rocks were hardened, tilted and folded, and finally subjected to erosion so widespread and long continued that the enormous accumulations of rock were wholly swept away over large areas, until they remained only in depressed tracts or synclines; such, for instance, as one found in the bottom of the Grand Canyon, where sediments not less than 12,000 ft. thick are found as a mere remnant protected from the general destruction through having

been squeezed into a trough that extended below the level of effective attack. At the tops of these troughs the tilted beds of quartzite often project some distance into the overlying rocks, showing that before the erosion had been completed they had become harder and more resistant than the neighboring granites and schists, and had formed low hills and ridges in the rolling plain which was the expression at once of a worn-down continent and of a cycle of recurrent geological agencies.

Theories of Formation of Jerome Deposits

From this assemblage of fact and inference, I believe it is possible to make an intelligent conjecture that the ore deposits of Jerome were formed from igneous action which accompanied the uplift and mountain building that occurred at the end of the Belt period of deposition. The diorites of Jerome in which, or along which, the orebodies occur are comparatively fresh and massive. This fact is marked enough to make it seem certain that they had not participated in the metamorphism, deformation and erosion of the continent that preceded the Belt rocks. The fact that the Belt formations contain practically no interbedded volcanic material, both in general and in the areas nearest Jerome in particular, is good and almost positive evidence that this extensive igneous activity did not take place during the period of Belt deposition. It is possible, therefore, to come naturally to the conclusion that the Jerome rocks appeared during the uplift which brought the Belt period to an end. Under this assumption, I can see no difficulty whatever in picturing the succession of events. As was the condition with the Belt rocks, the Jerome intrusives suffered the long-continued erosion and oxidation which continued in the mountains of the post-Beltian and pre-Cambrian continent. Like the Belt quartzites, they finally projected as low hills, covered with reddish soil—hills so low that they would have attracted little attention in the slightly rolling landscape.

Copper Deposits Likely at Bottom of Grand Canyon

There are no Belt rocks at Jerome and none are known nearer to it than the Grand Canyon. These supposed relations between the Jerome ore deposits and the disturbances which ensued upon the termination of the Belt period of deposition are not based, therefore, upon direct evidence, but rest upon conjecture, or, to call it by a more dignified name, upon a process of reasoning. But it diminishes the scope for guesswork, and adds something to the probability of my conjecture, to find that in the bottom of the Grand Canyon there are copper deposits which have precisely the broad geological relations which I have pictured for those of Jerome. L. F. Noble[1] describes these deposits as fissure veins which cut across both the Unkar Group (Algonkian or Belt) and the underlying Vishnu schists (Archæan). To be specific, the facts are as follows:

1. The Unkar group contains great intrusions of diabase, similar, no doubt, to some of the rocks at Jerome. The copper-bearing veins are fault fissures cutting the Unkar rocks but terminating at the overlying basal sandstone of the Cambrian. Speaking of these deposits, and of the conditions of formation, Noble says:

> All the other deposits in the Archæan and Algonkian rock occur either in similar fissure veins, which represent the mineralized fault planes of normal Algonkian faults, or in the zone of shattering along the line of the Algonkian displacement of the West Kaibab fault. All the faults belong to the same period of displacement, the one in which the great mountain-making movement came at the end of Algonkian time.

2. I have not yet recited the facts upon which may be based another interesting conjecture. Jerome is situated at the edge of a broad area of Archæan rocks which has a width toward the southwest of 250 miles. Upon this surface there are a few scattered patches of Palæozoic sediments, and many recent accumulations of volcanic rocks as well as of desert detritus, but this covering is only partial and shallow. The area looks as if it might be a zone extending, with some modifications, such as the relative amounts of Palæozoic strata occurring upon it, for a long distance northwest into Nevada and southeast into Mexico. Throughout its length, no characteristic Belt rocks are known upon it, or, at least, they do not appear in Bayley Willis' map of 1911.

Southwest and Northeast of Jerome Differ

At any rate, the area southwest of Jerome is an almost continuous exposure of crystalline rocks, bearing plain evidence of erosion that has worn far down into the earth's crust. If the Belt rocks ever covered it, they have been swept away; if Palæozoic rocks covered it once (they certainly did in part), they have been practically swept away. Neither Mesozoic nor Tertiary rocks occur on it except as volcanics, and perhaps patches of talus that are not the sediments which go into depressed areas, but are the immediate products of faulting and uplift.

The zone northeast of Jerome, the plateau region, is of opposite character and geological experience. Since Archæan times, with some interruptions, such as the present and the period of post-Beltian and pre-Cambrian erosion previously considered, it has been prevailingly a dumping ground for the products of erosion. It contains the Algonkian Belt series, 12,000 ft. thick at the Grand Canyon and 25,000 ft. thick in Idaho; it contains, also, a large amount of Palæozoic, Mesozoic and Tertiary sediments, all of which have been deposited either in the sea or in low-lying depressed areas. It has finally been elevated into a plateau, but its solid mass has not been shattered. It has recently been penetrated by igneous activity, no doubt as a part of the process of uplift, but this event is practically a new experience for the region, such as had not occurred before in the long ages from the pre-Cambrian to the Tertiary.

It is clear that the belt southwest of Jerome, as compared with that northeast of it, has been prevailingly a belt of erosion. To explain this one has the choice of two suppositions, either of which points to about the same conclusion: the belt may have been the seat of active sedimentation interrupted by periods of intensive erosion, which means that it must have been elevated into high mountains, or it may never have been depressed enough to receive much sediment, which would indicate that it has been continuously a mountain area, but not necessarily in high ranges. There is no escape from the deduction that it has been a belt of elevation. Nor does it lack what I am convinced is a general concomitant of mountain building, for it contains.

[1] "Shinumo Quadrangle," U. S. G. S. Bull. 549.

at least along its eastern border, abundance of batholithic igneous intrusions.

My conjecture from these broad facts is that Jerome lies on the line which separates a zone of prevalent upthrust from a zone of prevalent subsidence. Such a line is naturally one of flexure and rupture, or, in other words, a line of weakness. It may be assumed that such a line has frequently divided a sea from the land, or a mountain front from a plain. It is, in fact, not a line but a zone of varying width. I think it reasonable to suppose that the mountain zone of Arizona as defined by Ransome has this general significance; that it is a zone of permanent or recurrent weakness between two comparatively solid blocks of the earth's crust, along which several strain adjustments on a continental scale have taken place; that these adjustments have found relief in many fusions of deep-seated rocks; that these fused masses have penetrated upward to or near the surface in the form of stocks or batholiths; that these batholiths gave off into the enclosing rocks the streams of mineralized gases or solutions which produced the ore deposits; and that, consequently, the ore deposits lie generally in the zone of weakness which finds some expression in the elevation or depression of bordering areas, therefore in the processes of erosion and deposition, and finally in the geography and topography of the continent. Thus one may perhaps hope to establish a more or less clear relationship between the processes of erosion, sedimentation, mountain building, batholithic action and magmatic ore deposits, and even with the expression of the processes in the major topographic features.

Formation of Jerome Deposits Contemporary To Those of Lake Superior and Canada

3. If it be logical to regard these conjectures as measurably correct, there is reason to argue that the ore deposits of Jerome may belong to the same cycle of continental history as the copper mines of Lake Superior, the copper-nickel deposits of Sudbury, the silver deposits of Cobalt, and perhaps the gold mines of Porcupine, Ontario. These deposits are all connected with batholithic, or at least volcanic, masses along a tolerably well-defined axis. They may all belong, as has been suggested to me by Prof. C. K. Leith, to the same period of mountain building. The broad facts, on which conjecture may be based, are as follows:

The Upper Huronian, or Animikie, series of Lake Superior, as well as certain earlier rocks separated from the Animikie by an erosion interval or moderate unconformity, is an example of normal sedimentation on an extensive scale. Following a long period of continental quiescence, during which erosion forms had reached mature stages, there ensued a slow subsidence and sea invasion. The first deposits were sandstones or conglomerates, merely the washed débris of land weathering; following these were chemical deposits or precipitations such as usually take place in deepening waters, limestones and the peculiar iron formations; finally, deposits made after the subsidence had come to an end, and erosion products from the land rapidly filled the shallowing basin—shales and sandstones.

Then followed an outburst of mountain building or continental readjustment, during which certain areas of the rocks described were dislocated and contorted, just as rocks have been dislocated and contorted along many mountain-building axes in other places in later times. This disturbance was accompanied by igneous activity on a tremendous scale, producing innumerable batholiths or intrusions, as well as great piles of surface volcanics or extrusions. The Keweenawan series, the copper-bearing rocks of Lake Superior, was such a pile. It consists of a succession of thick lava flows separated by beds of coarse erosion products or talus, such as invariably accumulate on mountain slopes. As the process went on, the volcanic activity lost its vigor, the intervals between eruptions became longer, the accumulations of débris greater, until finally the eruptions ceased altogether and the lowlands around or the depressions between the volcanic piles were swamped in a huge mass of talus which differs in no essential respect from the wash that fills the depressions between the fault blocks of Arizona.

It seems to me that this Keweenawan series, then, is distinctly a record of continental disturbance, the reverse of the period of quiescence and marginal deposition of which the Huronian is the record. With the closing of the Keweenawan disturbance, the Lake Superior region settled into a state of crustal quiescence which has lasted to the present day. During Palæozoic and again in Cretaceous times it was quietly depressed, so that it received a partial invasion by the sea, the record of which is sediment still undisturbed and almost unconsolidated. In all its major aspects, this succession of events is on all fours with that recorded for the Belt series, the mountain-building interval, and the Palæozoic of central Arizona; and it is a fair inference that the copper deposits of Jerome belong to the same line in the geological column and to the same set of general causes as those of Michigan.

Structural Features of Jerome Ore Deposits

A great deal remains to be learned about the structural features that govern the occurrence of the deposits in the Jerome district, but one salient fact appears to be established—the ores are distributed along the contacts of intrusive masses of an augite diorite. All the masses of this diorite now known may easily have been originally one, which has been divided by faulting, but this is not yet a definitely proved fact. This diorite is next to the youngest of the pre-Cambrian rocks of the district, but it is cut by a set of dikes which are also a kind of diorite, but are narrow. The orebodies are younger than the great diorite intrusions but older than the narrow dikes. The massive diorite, which may be designated the United Verde diorite; the orebodies and the narrow dikes, which are known by the rather extraordinary name of "water courses," are all undisturbed except by recent faulting, and plainly did not participate in the mountain-building stresses which affected the other pre-Cambrian rocks. They are, however, definitely pre-Cambrian in age. The whole process of formation was completed, the ores were exposed by erosion, oxidized to a depth of 500 ft., the copper had migrated to the zone of secondary enrichment, and the orebodies brought completely into their present condition before the invasion of the Palæozoic sea.

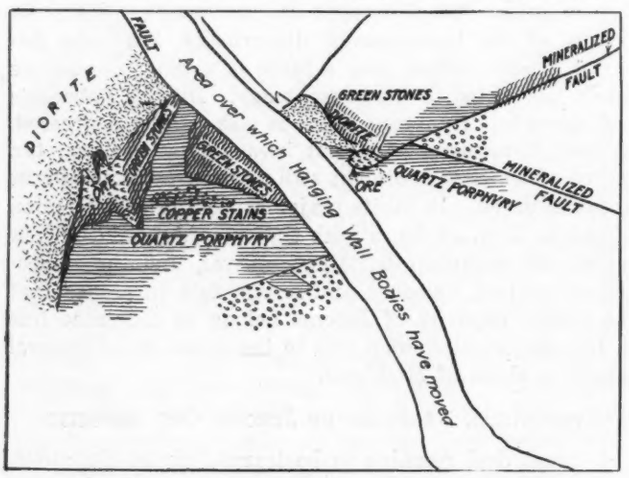
The rocks cut by the United Verde diorite are all ancient volcanics, either intrusive or extrusive. Some of them may be of pre-Algonkian age, on the theory that

the United Verde diorite is post-Algonkian, because they have been subjected to stresses vigorous enough to give them a widespread schistosity; and I suppose this must indicate that these rocks participated in mountain-building movements that occurred before the Belt rocks were deposited.

Relation of Greenstones and Quartz Porphyries

The oldest rocks seem to be prevailingly greenstones, many of which are undoubtedly extrusives, often in the form of bedded tuffs, although a good many of these are of medium acidity and have a gray or dark color. These greenstones are often considerably folded, in axes running, generally, north and south. Into these greenstones a mass of quartz porphyry has been intruded, and forms the high ridge called Cleopatra Hill, just south of the United Verde mine. It is with this north border of the quartz porphyry mass that the present article is chiefly concerned, for the zone of mineralization follows it fairly closely.

As a whole, the quartz porphyry is a large irregular



GEOLOGICAL SKETCH MAP, JEROME DISTRICT

mass, the outlines of which are vaguely known at its west end, but not at all toward the east, where, beyond a great fault, it is generally covered with Palæozoic limestones and recent lavas. It is certainly intrusive into the greenstones and irregular in outline, probably sending off several spurs from the main mass, and extends along an approximately east-and-west course from southwest of the United Verde to and beyond the Texas shaft, a distance of two and one-half miles. The north boundary of this mass cuts across the bedding or schistosity of the greenstones nearly at right angles and forms a rude plane, which dips generally northward at an angle of perhaps 60°. It is a notable fact that this porphyry, which in its center approaches a granite in texture, has been strongly sheared, and a pronounced schistosity has been developed in a large part of it. Some portions, however, especially the southwestern part, have been much less affected by the shearing and are still massive. The pronounced schistosity begins at the United Verde mine and continues eastward as far as the rock is exposed on the surface. This schistosity has a strike of about N 20° W and occurs in bands of greater and lesser intensity.

So far as known at present, the intrusions of United Verde diorite do not penetrate into the mass of the quartz porphyry, but seem to follow along its contact. Sometimes the diorite cuts across branching arms of the quartz porphyry and in places comes in contact with the main mass; but large wedges of the schist are included between the irregular boundaries of the two intrustions. It would appear that the greenstones near the contact formed a weak zone, which was followed, at least in a general way, by the diorite intrusions. As intimated previously, the diorite is strikingly fresher than the older rocks, and the contrast between its massive structure and the extremely schistose part of the quartz porphyry attracts immediate attention. As the diorite is patently a younger rock, one is inclined to wonder why it did not force itself in along the planes of schistosity, instead of going across them; but that it did not do so warrants the conclusion that the greenstones border must have been, on the whole, less resistant than even the most schistose bands of the porphyry. All the known valuable orebodies of the Jerome district occur in these greenstone schists, which form the border of the quartz porphyry, or are within the latter rock near its periphery.

(To be continued)

Soldier and Sailor Insurance

The business of insuring the soldiers and sailors in the service of the United States is scarcely a year old, and yet the Government has written more than $30,000,000,000 of insurance, insuring approximately three and a half million soldiers and sailors. This gigantic business, employing 10,000 individuals and doing a greater business than the largest insurance company of the world, has all been organized in less than 12 months. The bureau recently has been doing a business of more than a billion dollars a week; the total for the month of August will approximate $5,000,000,000 in new insurance. On one day 92,253 pieces of mail were received.

It is a great work, an intricate work, a work of which every American approves. More than 90% of the members of the country's military and naval forces are insured, and this insurance has strengthened the morale of our fighting men and brought comfort and courage to their dependents at home. In addition to the insurance there are added soldier and sailor family allotments and Government allowances to dependents, the disbursement of allotments and allowances already totaling more than $140,000,000.

Alaska Road Taps Matanuska Field

The Government railroad in Alaska between Anchorage and Seward has been completed, the Department of the Interior has announced. This makes possible the shipment of coal from the Matanuska mines directly to Seward, a distance of 190 miles. It will also furnish transportation facilities to the coast for the agricutural products and minerals which that vast territory will produce in the future. Sixty per cent. of the railroad is now ready for operation, and it is expected that before the end of the present season rail will also be laid from Nenana, which is about 400 miles inland, southward 50 miles to Lignite Creek, which will make the lignite coal in the Nenana fields available.

Shaft Sinking at the Seneca Mine

BY W. V. FEATHERLY*

The excellent progress made in sinking the Seneca shaft is the result of a well-planned organization, and each process and all branches of the work have been carefully considered. A bonus system has been instituted; a method of blasting whereby good breakage of the ground is obtained is used; certain men are entrusted with specified duties, and matters pertaining to the safety and comfort of the men are given special attention.

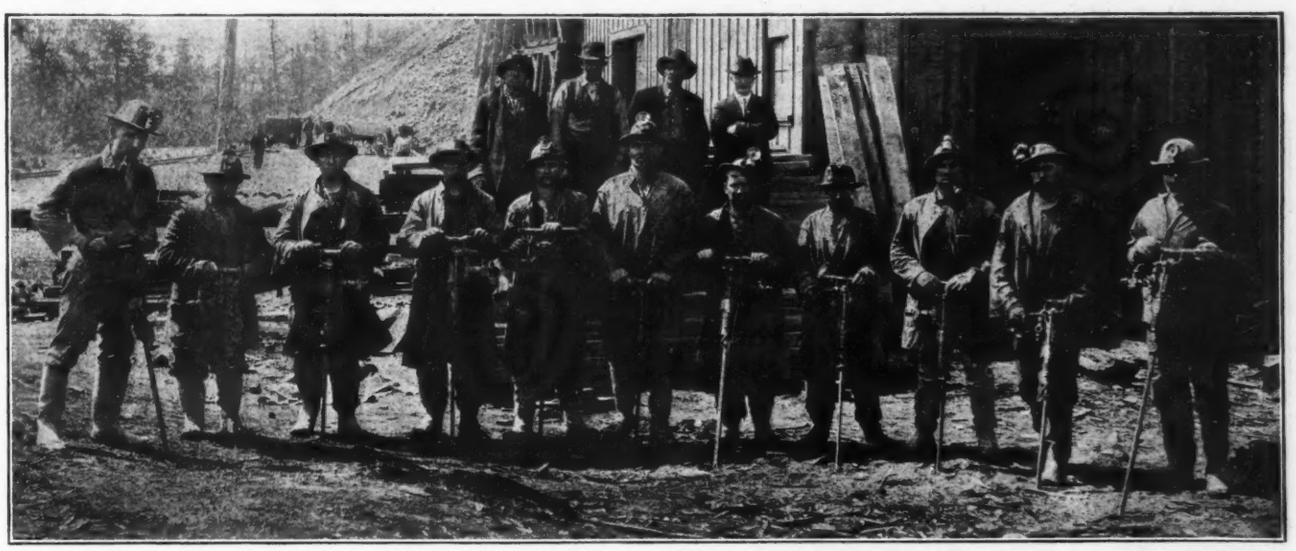
THE Seneca Mining Co., at Mohawk, Mich., is sinking a compound shaft, which is to be vertical to a point 1450 ft. from the surface and will then follow a 400-ft. radius curve to meet the Kearsarge lode, which dips at an angle of 34° from the horizontal. The equipment and methods adopted in sinking are in accordance with modern practice, and the progress made has established a record for shaft sinking in the Lake Superior district.

The shaft is to be of four compartments, having two skipways, one ladderway and one pipe compartment. Over-all dimensions of the excavation are 11 ft. 4 in. x 21 ft. 4 in. and steel sets of 5-in. H-beam construction are placed at from 6 to 8-ft. centers, depending upon the nature of the ground. These sets are put in so that they are placed 4 ft. from the bottom when the ground is soft, up to 30 ft. from the bottom when the ground is hard. The lagging is of 2-in. hard wood.

A double-drum steam hoist operates two 36-cu.ft. buckets. Air is furnished by one Sullivan tandem-compound, Corliss steam-driven compressor, and one class WB-2 Sullivan straight line, simple steam, two-stage air compressor is installed as a reserve. At the beginning of operations eight Sullivan DP-33 air tube rotators and eight hand hammer-drills of another make were in use. It was soon obvious that the Sullivan rotators were securing better results. Four more Sullivan rotators were purchased in April, and since that time 11 have been in constant operation, and two kept as spares. The header, shown in an accompanying cut, is connected to the main air line by a 3-in. hose and is supported in the center of the shaft while drilling by means of a cable leading from the steel framework. There are 11 hose lines, each 14 ft. long and leading from the bottom of the header to the drills; also one connection for a blowpipe.

EARLY PROGRESS MADE UNDER HANDICAPS

Excavation was begun on Feb. 13 during severe weather conditions as well as other handicaps. Water froze in the buckets, there were no steam lines installed in the shafthouse, and the rock had to be trammed by hand. Three shifts were worked, with only four or five men on a shift, and under these conditions progress was slow. During February, 51 ft. was sunk, and in March 113 ft., with conditions about the same. Early in April the rock-disposal haulage outfit was completed, the headframe inclosed, and steam heating coils were installed, so that 154 ft. of shaft was sunk during that month. By increasing wages 50c. per day the management was able to secure sufficient men by May 1, and since that time the work has been carried on at full capacity, the crew averaging ten men and one shift-boss per shift, and working three shifts.



SHAFT CREW WITH HAND HAMMER-TYPE DRILLS USED IN SINKING SENECA SHAFT

During May 208 ft. was sunk in 27 working days, and this rate was maintained in June, when 195 ft. was sunk in 25 working days. This figure would have been exceeded had not the men encountered loose, soft ground, which caused considerable delay, as it was necessary to keep the steel work close to the bottom of the shaft to guard against loose rock falling on the men.

The bonus system which has been adopted consists of the following: The men receive a flat rate per day up

*Walker Bank Bldg., Salt Lake City, Utah.

to the first 100 ft. per month; 2c. per foot per day for all over 100 ft. up to 150 ft. per month; 3c. per foot per day for all over 150 ft. up to 200 ft. per month, and 4c. per foot per day for all over 200 ft. per month. This provides an incentive for the men to work hard, and each shift tries to send up more rock than the previous one. The shifts are well organized, and the same men have their regular work to do each time they blast. Two men attend to the raising and lowering of the header, which is hooked on the bottom of one bucket. The drills are taken up in the other bucket. One man looks after the main wires while the others are charging the holes and getting the tools up. The last two men connect the main wires. One of them inspects everything at the last minute and carries the key to the blasting switch.

Method of Charging and Blasting

In blasting, electric igniters and blasting caps are used. The bottom of the deeper holes is charged with 60% powder, 45% being used in the remainder. The average depth of hole is 8 ft., and the round of 45 holes is drilled in from two and a half to three hours. The "sink" is made with a double V-cut, and is shot in two separate blasts, the cut holes being fired first. In the diagram, cut holes numbered 1, 2, 3, and 4, are shot in that respective order with instantaneous and delay caps.

AIR HEADER USED IN SINKING SENECA SHAFT, MOHAWK, MICHIGAN

If all of these holes break satisfactorily, the squaring holes numbered 5, 6, and 7 are set off. This plan insures the breaking of the sink holes before the ends of the shaft are squared. Thus far, two pounds of explosive per cubic yard of rock has been the average.

Eight construction men are employed in placing sets while the men are drilling and not using the buckets. In drilling, ⅞-in. hollow drill steel is used, and this is sharpened and shanked by machine.

Ventilation is secured by means of a 7½ hp. blower, which forces fresh air through a 16-in. Flexoid tube. With this equipment it is possible to return to the bottom of the shaft in less than ten minutes after blasting. Light is furnished at the bottom of the shaft by two factory domes, with four 100-watt lamps in each dome. The men are required to wear special hard hats, made

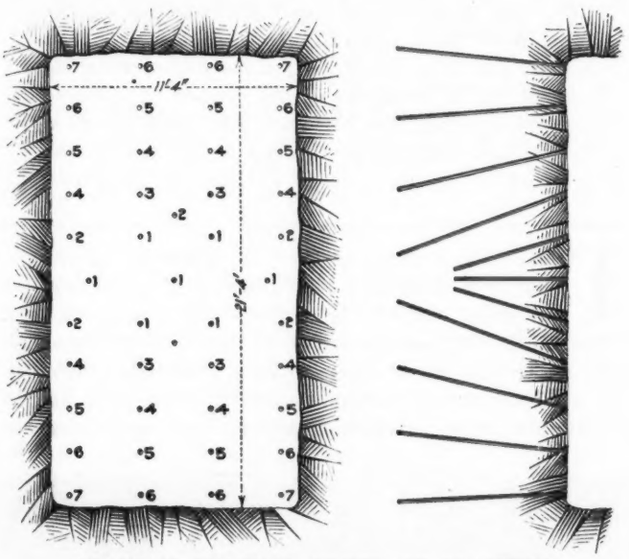


DIAGRAM SHOWING ORDER OF BLASTING AT SENECA SHAFT

of felt, treated with resin and shellac, which will resist a severe blow. Movable sollars, made of steel plates and operated by levers, are placed over the two compartments used for loading supplies in buckets. When the bucket hangs at the brace, the lever is thrown and the plates close in around the bucket, making practically a complete cover over the compartment. Electric signals are employed throughout.

Magnesite in First Half of 1918

According to R. W. Stone, of the U. S. Geological Survey, the production of magnesite in the six months ended June 30, 1918, was about 93,700 short tons, of which California produced more than half. The best figures available credit California with an output of about 47,600 tons of crude magnesite and Washington with 46,100 tons. Only two companies were producing in Washington, and one of these stopped quarrying from February to May in order to enlarge its calcining plant and develop the deposit. The rate of production in California is about 50% less than in 1917, and the rate in Washington is about 88% of that of last year. The output of California in the second half of 1918 will probably be no larger than in the first half, but that of Washington may be much larger, for development has now reached a stage where rock can be quarried, calcined, and shipped at an increased rate. The production for the entire year may be about 225,000 tons, as against 316,000 tons in 1917.

The increased freight rate and the importation of magnesite from Canada have greatly reduced the demand for California magnesite for use as a refractory material, so that all the small and some of the large producers have stopped work.

Important Physical Properties of Acid Refractory Materials and Methods of Estimation*

By G. E. FOXWELL

The more important physical attributes of firebricks are considered, together with data showing on what each property depends. Various methods employed for measurement of the important characteristics are described. The peculiar composition of a firebrick necessitates the consideration of many details, such as softening prior to liquefaction, permanent contraction, thermal expansion, and slag permeation, all of which subjects are here discussed in detail.

WHEN a chemically pure substance such as naphthalene or picric acid is heated slowly, it melts at a definite temperature; there is no "softening range," but a sharp melting within one-tenth of a degree. If, however, impurities are present, the melting does not occur sharply, but extends over a wide range, which is greater as the substance contains greater quantities of impurity; there is no definite melting point. This is the condition met in bricks. Bricks are agglomerates of many different substances. Thus a common firebrick containing, say, 65% of silica will consist of quartz, cristobalite, tridymite, sillimanite, and a variety of other bodies containing lime, soda, potash, magnesia, iron oxide, and titania in their composition. Sillimanite melts at 1816° C., quartz at 1770° C., cristobalite at about the same, and tridymite (of which such a brick will contain little) probably melts at about 1500° C., according to Endell and Rieke. It will be noted that at least 80% of the brick melts above 1750° C., and yet the softening temperature is probably under 1650°. A brick may show signs of softening at 1600° and yet not be liquid until 1800°. The matter is further complicated by the fact that one constituent may fail in such a way as to make the brick change its shape under a slight pressure, and yet the surface of the brick will show no sign of fusion. Under these circumstances it is obviously difficult to determine the melting point in a satisfactory manner.

Use of Seger Cones

Until recently the only test attempted was to determine the melting point, or rather softening point, under atmospheric conditions. By common consent, this is defined as the temperature at which the exterior surface of the brick exhibits signs of fusion. The temperature is usually measured by means of Seger cones. The pyrometer is undoubtedly a more scientific instrument, and for measuring the temperature of fusion of a pure substance of high melting point it is far superior to the Seger cone. For determining the melting point of such a complex agglomerate as a firebrick, however, the Seger cones possess advantages.

If a thin section of firebrick could be observed under the microscope while being slowly heated from atmospheric temperature up to its temperature of complete liquefaction, it would be seen that certain constituents (fluxes) would melt at a relatively low temperature. Thus, ferrous silicate melts at just above 1000° C. As the temperature rose, other fluxes would be seen to melt. The quantity of flux melted up to, say, 1300° C. would be small, but if the temperature were maintained at this point the molten flux would either dissolve or interact with the adjacent parts of the brick, and so the molten areas would increase. This action would be slight at 1300° C., but at 1400° to 1500° it would become serious. A brick which when heated at the rate of 10° C. a minute melted at 1600° C., when heated at 2° C. a minute might fuse at 1500°. Hence speed of heating is important.

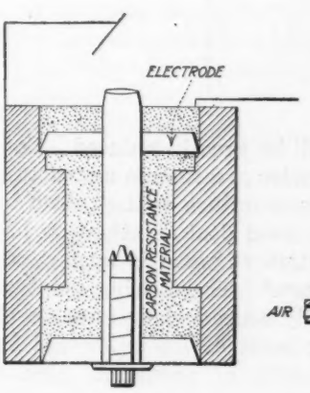


FIG. 1

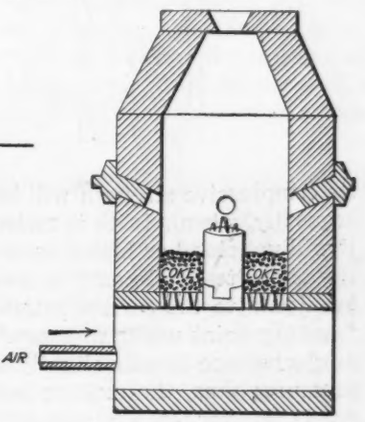


FIG. 2

Seger cones are so made that they collapse at specified temperatures when heated at a specified rate—namely, 10° C. per minute. This same rate of heating is specified for the determination of the softening point of bricks. It is clear, therefore, that if the rate of rise of temperature in any test is not exactly the same as that specified, the Seger cone method will tend to neutralize the error. The refractory test is, after all, only empirical. It merely permits of comparing one refractory with another.

Method of Operation

The test is carried out by placing a piece of brick, chipped roughly into the form of a cone about 1½ in. in height, on a small disk and placing round it three or four Seger cones which have softening points at about the temperature at which it is expected the brick will soften. The brick and cones are then cemented to the disk by a suitable cementing material, and the whole is placed in a furnace. Usually Hirsch's electric furnace is used, though some prefer Deville's gas-fired furnace. Heat is then applied, the temperature being raised at the rate of 10° C. per minute. When the temperature gets within 100° of the expected softening point, it is necessary to watch the sample carefully. A skilled observer can tell exactly when the surface of

*Abstracted from "The Iron and Coal Trades Review."

the brick fuses, but if there is any doubt it is well to withdraw the sample from the furnace for a few seconds, when it is easy to tell if the fusing temperature has been reached or not. Fig. 1 gives a sketch section of the Hirsch furnace, and Fig. 2 one of a coke-fired furnace for the same purpose. An apparatus of a different type has recently been brought out in the United States. In this a minute fragment of the material under investigation is placed in such a position as to be surrounded by radiant heat. Observed under a magnifying glass, it is possible to tell the exact instant at which fusion of the surface occurs.

As mentioned, parts of brick will fuse long before the fusing proper, as shown in the described test. When this happens, the brick will be partly liquid, and hence

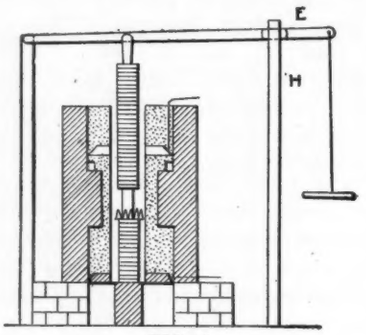


FIG. 3

its compressive strength will be greatly reduced. Consequently, when a brick is under pressure in a structure it will not stand as high a temperature as that given by the above test. Recently a good deal of attention has been paid to the determination of what is termed the "melting point under pressure." The melting point of any substance is only slightly depressed by increase of pressure; thus, the melting point of ice is lowered by 0.007° C. for each atmosphere of pressure. Hence, what is really measured in this test is the temperature at which a brick becomes sufficiently viscous to flow under a given pressure, and it is of much more use industrially than the previous one, and, in my opinion, will entirely supersede it in the near future.

Modified Hirsch Furnace

For measuring the resistance to pressure at high temperature Dr. Mellor has devised a modification of the Hirsch furnace which has the advantage that it permits the furnace to be entirely used for either form of melting-point test. His apparatus is shown in Fig. 3. He employs specimens of cylindrical shape 6 cm. (2.3 in.) in height and 2 cm. (0.8 in.) diameter. This test piece is placed on a refractory block, which stands on a solid foundation, and is surrounded by Seger cones, as shown in the sketch. A thick graphite rod is used for transmitting the pressure to the specimen. Reference to the sketch will show the manner in which the load is applied. In order to determine the exact point at which distortion of the test piece begins, a mechanical device is employed. A binding screw is fixed to the arm of the lever *E* carrying the weights. A similar screw is fixed to the support *H*. These two pins are insulated from the rest of the apparatus, but are in circuit with an electric bell. When the test piece is distorted, the lever arm *E* falls and the two screws make contact and ring the bell.

Fig. 4 shows a more elaborate apparatus designed for the same purpose by Ezer and Griffiths, and described by them in a paper read before the Faraday Society. The furnace is of the carbon-tube resistance type. The specimen employed is cylindrical, $\frac{5}{8}$ in. diameter and 1 in. in length. It is supported on a carbon rod, and a similar rod on top is used for transmitting the pressure. The pressure is created by a spring instead of a weight and lever arm, as in Mellor's apparatus. The carbon tube is 2 in. external diameter, $1\frac{1}{2}$ in. internal diameter and 11 in. long. A slot $\frac{1}{4}$ in. wide extends the entire length of the furnace in order to allow the specimen to be seen. In this case no mechanical device is employed to let the observer know when the fusing temperature has been reached, but the test piece is observed throughout the whole period of testing.

The testing of refractory materials under load requires great care. In the first place, it is necessary to grind the opposite ends of the specimen exactly flat and as nearly parallel as possible. If not ground absolutely parallel, it is necessary to allow the carbon rod used for transmitting the pressure to take up its own

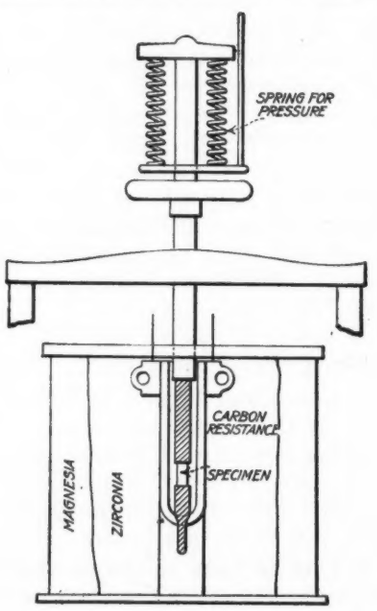


FIG. 4

position before putting any weight on it, so that it rests evenly on the whole face of the specimen. The temperature rise must be kept carefully to the standard—10° C. per minute. The area of the upper end of the test piece must be accurately known, for the pressure is measured in lb. per sq.in., and if the tests are to be comparable among themselves the same pressure must be used in each experiment. The greatest need in this connection is a handy apparatus whereby the pieces of brick may be accurately ground to a specific size.

Most materials expand on being heated, and on cooling contract again to their original size. Refractory materials are no exception to the first part of this generalization, but they do not return to their original size on cooling. Firebricks undergo a permanent contraction on heating. This is due to fusion of small quantities of fluxes, as already mentioned, which allows

surface tension to come into play, resulting in the drawing together of the grains. Silica bricks, on the other hand, undergo a permanent expansion in use. This is due to the inversion of quartz to cristobalite, which is never completed in the brick kiln. This "permanent" expansion or contraction is comparatively easy to measure. A test piece about 4½ in. long and 2½ in. thick is measured carefully, marks being placed in order that the calipers may be put in the same position after the test. The calipers should read to within 0.01 mm. The test piece is then placed in a furnace and maintained at a specified temperature for two hours. This temperature is Cone 12 for material containing more than 80% of silica and Cone 14 for firebricks, according to the Gas Engineers' specification. At the expiration of two hours, the furnace is cooled, and when cool the test piece is again measured. The expansion or contraction observed gives the figure required when expressed as a percentage.

Measurement of Thermal Expansion

The true thermal expansion is difficult to measure and requires a special and expensive apparatus devised by Baron Coppée. Two saw cuts are made in a whole brick near the ends and platinum wires fastened into each cut. The distance apart of these wires is taken while the brick is cold. It is then placed in the furnace and the distance measured through suitable apertures by means of a cathetometer. The expansion thus found is not the true thermal expansion but the resultant of the thermal expansion and the "permanent" expansion or contraction. In order to obtain the true expansion, it is necessary to take the brick up to the required temperature, measure the expansion, then let the brick cool again and measure any "permanent" expansion or contraction which may have occurred. This point has been often overlooked.

Permeability or Slag Penetration

This test is of great importance in certain industries, and is one of those for which no standard method has been evolved. The American Society for Testing Materials recommends the following method, which is given as representative of the kind of method employed: A hole 2½ in. in diameter is cut with a drill pointed at an angle of 150° to a depth of ½ in. at the side. The hole is cleaned out and the brick heated to 1350° C. A known quantity of powdered slag is placed in the hole, and the temperature maintained at 1350° for two hours. The brick is then allowed to cool and is sawn in two pieces so as to bisect the original hole. The total area of slag penetrable is measured by means of a planimeter. Nesbitt and Bell, the originators of this method, find that the quantity of slag taken and the time of heating, provided this extends over two hours, do not materially affect the result.

I hold that since only comparative tests are required, the following modification of the porosity test would give as valuable results as this somewhat elaborate method: A piece of brick is dried at a red heat and weighed. It is then immersed in boiling water for an hour and the water allowed to cool with the brick in it. The increase in weight gives the total space of those pores which are penetrated by slag, as distinct from those which are totally closed.

In most cases a highly important property of firebricks is that of resistance to sudden changes in temperature. In the coke oven, just before discharging the coke the temperature of the wall will be 1000° C. or over; when the door of the oven is open for the discharging process the temperature of the inner face will drop to perhaps 950° C., though the side of the wall next the flue will retain its pristine temperature. On putting a charge of coal into the oven, the temperature will further drop rapidly to about 600° C., or possibly even lower than that on the inside, whereas the side next to the flue cools down more gradually and does not reach the same low level. It will be clear, therefore, that severe strains are likely to be set up in the coke-oven wall. Other instances of equally severe treatment might be cited from the iron and steel industry, but this will be enough to show the importance of this property.

There seems to be no definite test for resistance to temperature changes, and it is carried out only occasionally. The method usually employed is to take a whole brick very hot from a furnace, drop it into a bucket of water and endeavor to ascertain with the unaided eye if any signs of disintegration are visible. Professor Cronshaw has suggested that the test required is to raise the test piece to a certain temperature, allow it to cool rapidly to a lower temperature during a definite period of time by a definite means, and then carry out a determination of crushing strength.

Crushing Strength Determination

The crushing strength is a somewhat difficult property to measure and requires expensive apparatus. I have suggested a much simpler method whereby a measure of the altered condition of the brick may be ascertained without any special apparatus. The non-resistance of a brick to sudden changes of temperature is caused by the occurrence of numerous minute cracks, formed by the strains set up in the brick. The method suggested is to heat up and cool down exactly as indicated by Professor Cronshaw, and to ascertain the total amount of cracks produced. The test piece, whose volume is known, should be boiled in water for an hour before testing, allowed to cool in the water, and then weighed. After the test, this process is repeated, and the increase in weight will give a measure of the cracks which have been produced. The brick is first raised to a temperature of 1000° C. in a muffle furnace and then plunged suddenly into cold water. This test is devised for coke-oven purposes. For other industries other initial temperatures will be required. Results obtained on two different bricks by this method are as follows:

	First Brick Tested	Second Brick Tested
Volume of brick, cc.	105	75
Initial weight of brick and water, gm.	218.502	155.222
Weight of brick and water after test, gm.	218.740	155.974
Volume of cracks produced, per 100 cc. of brick, cc.	0.230	1.003

Thermal Conductivity

This property is at present entirely a matter of experiment, and does not form the subject of any recognized test. Its measurement is perhaps the most elusive of all properties. It has been done by a few experimenters from time to time, but each finds it necessary to employ different apparatus from that employed by other workers. For a rough prac-

tical test, a bunsen burner may be allowed to play on one side of a brick, and the opposite face may be held in the hand. The time in which the brick becomes too hot to hold gives a rough indication of the relative heat-conducting powers of different bricks. This test, of course, is purely a practical one, and is of no value for definite measurement of the property.

I will endeavor to give an account of some of the methods which have been employed for measuring conductivity. From every point of view this is a most important property, and merits greater attention than has been given to it. The conductivity of bricks depends on two factors— (1) the amount of pore space in the brick, and (2) the material of which the brick is made. Air is one of the best non-conductors known, especially in small pores where not much circulation is possible. Consequently, the larger the pore space the slower the heat transmission through the brick, because the heat can pass only by radiation and not by conduction. The heat passes by conduction through the grain of the material of which the brick is made. The rate of transmission of heat by radiation—i.e., across the pores—is proportional to the difference in the fourth power of the temperatures of the surface radiating the heat and the surface receiving the heat. The conductivity across the solid part of the brick depends on simple temperature differences.

The first serious attempt at estimating the conductivity of brick was made by Wologdine, and his apparatus is shown in Fig. 5. As will be seen, it was necessary to make the brick of a special shape, which had a thickness of 5 cm. (1.9 in.) and formed a part of the walls of a furnace heated by gas. Thermocouples were embedded in the brick at a depth of 5 mm. from each face, and the furnace temperature was also taken by a thermocouple near the lower surface of the brick. The temperature of the water entering and

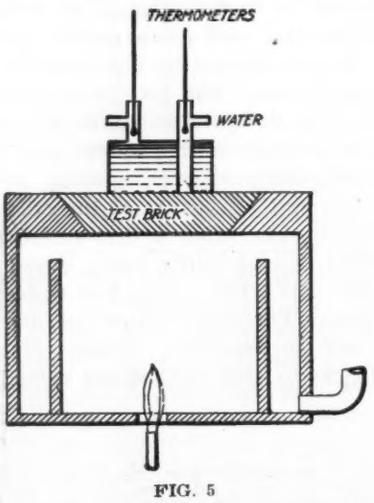


FIG. 5

leaving the calorimeter was measured, and the heat transmitted in the unit of time per degree difference of temperature between the faces was calculated. This method is not applicable to ordinary practice, as it requires a brick of a special size and shape.

Boyd Dudley has carried out experiments in America on a large scale. He built a whole wall of a furnace of the bricks under test and measured the heat transmitted through a definite area by means of a flow calorimeter. The bricks composing the wall were 9 in. by 4½ in. by 3 in. in size and the wall was heated by incandescent coke.

Dougill, Hodsman, and Professor Cobb have also carried out experiments on this subject. Their apparatus is shown in Fig. 6. It consists of a gas-heated furnace as shown, heated by a Méker burner using compressed air. The brick formed the roof of the furnace, and whole bricks were used. The temperature of each face

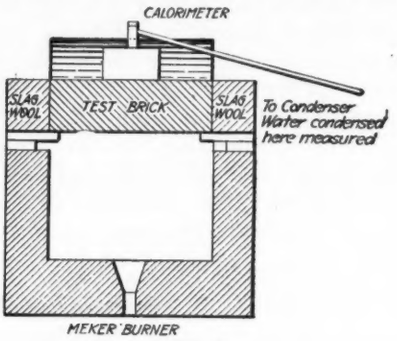


FIG. 6

of the brick was taken by thermocouples, as usual, and the amount of heat allowed to pass through the brick in a given time was obtained from the amount of water evaporated. The calorimeter used consisted of a rectangular copper vessel, which had a smaller rectangular copper flask fixed on to its base. As will be seen from the sketch, the water evaporated in this was measured, the water in the outer jacket of the calorimeter serving to prevent any loss by radiation. The apparatus seems to satisfy industrial requirements better than any other so far devised. The difficulty in apparatus of this type is to maintain a constant temperature and to maintain the temperature constant over the whole face of the brick.

Molten Metal Bath Method

Ezer Griffiths, of the National Physical Laboratory, has devised an apparatus whereby the lower face of the brick is heated by a bath of molten metal, thus ensuring an even temperature throughout. The temperature of this molten metal can be readily taken by a thermocouple. He uses a flow calorimeter to measure the amount of heat transmitted. The one employed is on the same principle as that of Wologdine, but it is surrounded by a further water jacket, as in the case of Dougill, Hodsman and Cobb's apparatus. Separate streams of water are allowed to flow through both the outer jacket and the calorimeter proper, and this prevents any serious temperature difference between the two. By regulating the streams of water, the temperature gradient of the water entering and leaving the calorimeter may be made the same as the temperature gradient of the water entering and leaving the outer jacket. Though these methods are useful for scientific purposes and precise measurement, for ordinary purposes an apparatus is required by means of which a whole brick may be placed in the calorimeter, and one surface heated to an even temperature by means of, say, an electric furnace, and a reading of the amount of heat which passes through it taken directly, without the use of thermocouples, which are expensive for industrial laboratories.

New Merton Roasting Furnace For Blende

The Merton blende-roasting furnace follows the regular standard design of the Merton furnaces in use for pyritic ores, but possesses several important modifications which serve to adapt it to the particular conditions of zinc-ore roasting. It may, however, be advantageously used for roasting other sulphide ores when a concentration of SO_2 gas is required for the manufacture of sulphuric acid.

The furnace is of the muffled or semi-muffled type, and a novel feature is the method of conveying the ore through it. Instead of rabbling from end to end of each hearth, as in the ordinary furnace, the ore is fed in two places to two separate sets of rabbles, and, in its progress through the several hearths of the furnace, is confined to the set of rabbles to which it was originally fed. It is finally discharged through individual chutes. This arrangement results in a more uniform and complete roasting of the ore, with a minimum production of hearth accretions; the fuel consumption is decreased by the utilization of waste heat; and the furnace may be readily adapted to different grades of ore by reason of the adequate control of the air supply and hearth temperature.

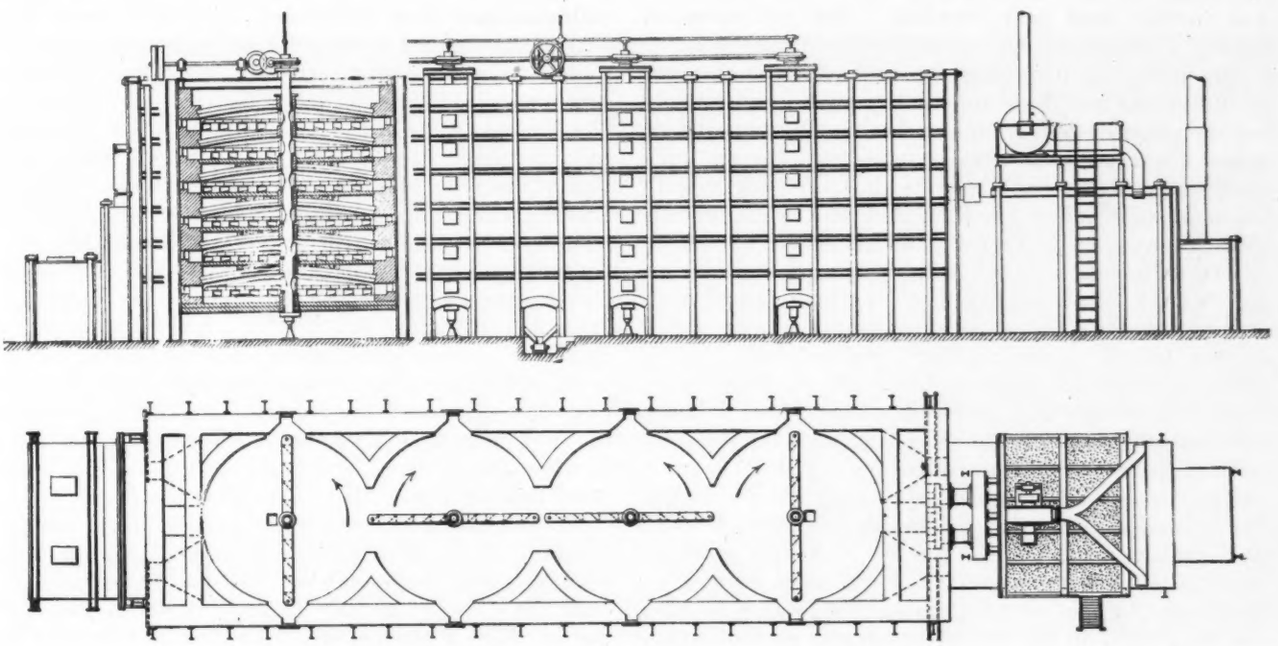
The furnace is of the muffled or semi-muffled type, the topmost hearth being available as a drying hearth, left uncovered, if desired, for the free escape of steam or vapor. The next three hearths are muffled hearths in which most of the roasting is accomplished and from which the gas evolved is collected for acid making. The incompletely roasted ore then passes on to the fifth hearth, which is open to the fuel gases and where all removable traces of sulphur are eliminated. The ore then passes to the bottom hearth, where it is cooled before discharge. The air used in cooling passes to the grade or combustion chamber, where the heat is utilized.

If the zinc is to be extracted by a hydrometallurgical process, instead of by the distillation method, the open-hearth could be dispensed with because a dead sweet roast would not be required.

It should especially be noted, as pointed out, that the ore does not traverse the whole length of the hearths, as in the ordinary Merton or other rectangular furnaces, but remains within the rabbling zone of the two adjacent shafts. In a four-shaft furnace two lots of ore pass simultaneously but separately down from hearth to hearth. The object of this separation of the rabbling into vertical zones is to overcome the backward motion of part of the ore which always occurs in existing multiple-shaft furnaces and causes uneven roasting. The ore is fed near to the center of one shaft and rabbled spirally inward and discharged near to the center, on the next hearth—and so on to the final discharge from the bottom hearth. The ore has thus a definite travel direction and is subjected to uniform conditions, both with regard to rabbling and to time of roasting.

A circular furnace fulfills these conditions of ore travel, but the hearth area is limited to the diameter of the furnace, and this, in turn, is limited by the necessity of keeping the roof of each hearth as low as possible. At the same time, it is difficult to obtain a uniform air supply to all parts of a circular hearth. The hearth area of the Merton blende-roasting furnace is four times the area of a circular furnace of similar diameter; and it may be still further increased by the addition of another pair of shafts, if desired, without affecting the efficiency of the rabbling.

The ore passes from hearth to hearth at points far removed from the gas outlets, so that loss in dusting is reduced to a minimum. The fuel gases, which pass through flues between the upper hearths and through the fifth hearth, traverse a regenerator before escaping to the stack. The air required for the combustion of the sulphur in the muffle hearths is pre-heated in the regenerator and delivered under slight pressure, by means of a fan, and is therefore under complete con-



SECTION DETAIL, MERTON BLENDE-ROASTING FURNACE

trol. The heated air resulting from the cooling of the roasted ore on the bottom hearth is utilized in the grate or fuel combustion chamber.

The formation of accretions on the hearth is largely to be attributed to overheating consequent on inefficient and unequal roasting, especially in the case of ores containing appreciable quantities of iron. In the Merton blend-roasting furnace, hearth accretions are reduced to a minimum.

Manganese Deposits in Cuba

Manganese ore is found in Cuba in Oriente, Santa Clara, and Pinar del Rio provinces; in Oriente Province the deposits are in three areas, one north and northeast of Santiago de Cuba, another south of Bayamo and Baire, and the third on the Caribbean coast, states a U. S. geological survey bulletin. The first two include the only extensive deposits on the island. In Santa Clara Province a little ore has been found near the Caribbean coast west of Trinidad, and in Pinar del Rio Province small deposits occur north of the city of Pinar del Rio and further west near Mendoza. The two areas in Oriente Province promises considerable production.

The ores occur principally in sedimentary rocks such as limestone, sandstone and shale, which are in places metamorphosed, but in the most heavily mineralized areas are associated with masses of siliceous rock locally termed "jasper" and "byate." At one locality the manganese and its siliceous associates are in igneous rocks, such as latite-porphyry and latite.

The sedimentary rocks with which the manganese deposits are associated are in some places nearly horizontal, but generally show dips ranging from a few degrees to 45° or more. These inclined beds usually represent portions of local folds. Some faulting is shown in the vicinity of certain manganese deposits and may have influenced the localization of the deposits.

The area north of Santiago and that south of Bayamo are both north of the mountain range known as the Sierra Maestra, but that on the coast east of Portillo is at the south base of this range. The area north of Santiago is, broadly speaking, in the basin formed by the Sierra Maestra on the south and the Sierras de Nipe and del Cristal on the north, the greater part of which is drained westward by Rio Cauto and its tributaries, and small parts of it by Rio Purgatorio and Rio Guantanamo to the south and east. The deposits of manganese ore are found on both sides of the basin. The deposits in the area south of Bayamo are in the foothills of the Sierra Maestra drained by the Buey, Bayamo, Yao, and Cautillo rivers.

The deposits in the two areas north of the Sierra Maestra show an interesting concordance in altitude. They stand from 500 to 1200 ft. above sea level, and most of them are at altitudes of from 600 to 700 ft., suggesting a relation between the deposition of the manganese and a certain stage in the physiographic development of the region. Most of the manganese ore deposits are above drainage level on the slopes of hills of moderate height, the maximum relief in the immediate vicinity of the deposits seldom exceeding 500 feet.

The deposits are rather diverse, but may be grouped into three general physical types—bedded deposits, irregular masses associated with siliceous rock or "jasper," and deposits in residual clay. The bedded deposits comprise several varieties, one of the most common consisting of poorly consolidated beds of sandy chloritic material cemented with manganese oxides that fill inequalities in the surface of hard rocks. Other bedded deposits clearly replace limestone, shale, conglomerate, or other rocks, and tabular masses of ore are interbedded with strata of nearly horizontal limestone.

The ore consists largely of pyrolusite, but many deposits contain psilomelane, manganite, and wad, or mixtures of all these minerals. The richness of the deposits varies considerably. Most of the richest masses are associated with the "jasper," but masses that have replaced limestone thoroughly are also shown on analysis to contain a high content of manganese.

Although the owners and operators of manganese properties in Cuba desire to speed up production while the need for the ore is great and the prices are good, there are certain hindrances, aside from climatic conditions, which tend to retard output. These can be removed to some extent if not altogether.

Difficulties of transportation of ore from mines to railroads have been mentioned, and there seems little chance for improvement without assistance from the Cuban federal government in building and improving cart roads. Haulage by caterpillar tractors may eventually supplant some of the haulage by animals. The high cost of animal haulage of course prevents the production of ore from many deposits at a distance from railroads. The limitation of this traffic to five or six months of the year further handicaps production.

Shortage of railroad cars and the inability of the Cuban railroad to handle adequately all the manganese ore during the dry season, when traffic is heaviest because the cane-grinding season also falls in this period, is an additional and serious handicap to the output of ore. For a time during the spring of 1918 a shortage of ships caused ore to accumulate at the docks in Santiago faster than it could be removed, but it is understood that conditions there have improved.

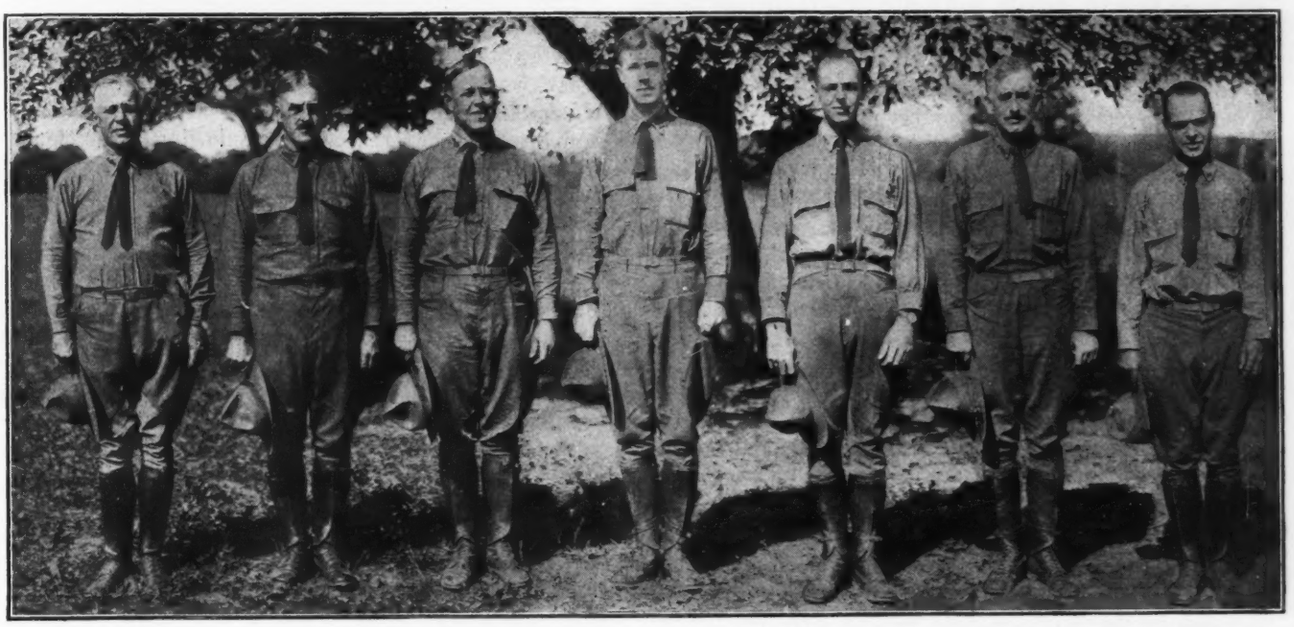
The marketing of ore by small producers is attended by more or less friction, between buyers and sellers, over sampling and analyses. It has been suggested that the United States Government detail two men, one of them a chemist and the other a man who has had experience in sampling ore, to act as umpires at Santiago in the sampling and analysis of manganese ore. Production seems to have been handicapped by the attitude of some owners of lands and leaseholds, who have raised the price of royalties so high as to discourage operations.

If railway cars and ships are provided for transporting the ore, food for the mine laborers, and explosives for blasting, the outlook for a steadily increasing production in 1918 and 1919 is good. It is believed that the total output for 1918 should be between 110,000 and 125,000 tons, more than 90% of which will contain from 36 to 45% manganese, the remainder being of still higher grade. After the completion of a narrow-gage track to certain important mines east of Cristo, in the Santiago district, in the summer of 1918, an increased output in 1919 is assured. Reserves of manganese ore in Oriente Province are estimated at 700,000 to 800,000 tons, more than 85% of which is in the district northeast of Santiago.

The 28th Engineers—A Quarrying Regiment

BY HORACE W. EDMONDSON*

ON AUG. 1, 1917, the Chief of Engineers issued orders to form a regiment of skilled quarrymen, to be known as the 28th Engineers. Some commissioned officers and a detachment of enlisted men formed the nucleus, and the regiment has been fully recruited with volunteers from various mining and quarrying sections throughout the United States and from selected men from the engineer training camps. The majority of the commissioned officers are graduates of the training camps of the Engineer Reserve Corps and are experienced mining, mechanical or civil engineers. Among the privates and non-commissioned officers are college graduates and men who previously occupied responsible positions in engineering industries. About 50% of the regiment is made up of men from the Middle and Western states; 45% from the Eastern section, with Pennsylvania representing 15%. In the remaining 5% are men who come from Alaska, Canada, Hawaii, Belgium, France and Italy.



STAFF OFFICERS, 28TH ENGINEERS

From left to right: 1, Capt. F. F. Pike; 2, Capt. A. D. Monteith; 3, Maj. C. T. Starr; 4, Col. C. R. Pettis; 5, Capt. D. Summers; 6, Capt. H. W. Edmondson; 7, Lieut. W. J. Dougherty

Col. Charles R. Pettis, of the Regular Army, is in command. On the staff are Majors Clarence T. Starr, Stuart B. Elliott and John T. Keenan. The Regimental Adjutant is Capt. Daniel Summers and the Personnel Adjutant, Capt. A. D. Monteith. Capt. Horace W. Edmondson is Engineer Officer.

The regiment as such has received training in quarry work as well as in military engineering. Each company has been organized to operate as a unit, by distribution of the skilled men by subsequent training. For training purposes, the authorities took over the quarry and crushing plant belonging to the workhouse of the District of Columbia, situated at Occoquan, and established a tent camp on the north side of Occoquan River, about one mile from the railroad town of Woodbridge, Virginia.

Three faces were exposed in the quarry, varying from 80 to 120 ft. in width and from 50 to 90 ft. high, in a disturbed shale formation, in which 65% gneiss occurs. About 1000 ft. north of the crusher plant lay a massive gneissoid formation, but the fractured condition of the rocks in the quarry afforded more thorough practice in drilling, in stripping and sorting of rock, so the latter site was selected. The bench system of from 15 to 20 sections is used, drilling being done by two Ingersoll rock drills, D-32 and D-44, mounted on tripods, using 1⅛-in. octagonal steel with crossbit. A Jackhamer, with ⅞-in. perforated hexagonal steel, is used in blockholing.

The main-track system and side-track switches are 30-in. gage, with a 25-lb. rail. Two-yard dump cars, hauled by mule to the foot of a 30° incline, dump into a No. 3 Austin gyratory crusher, and the product is elevated to a 48 in. x 12-ft. trommel, from which the plus 2½-in. material is delivered to a No. 6 Austin gyratory, which returns to the same circuit as the discharge from the No. 3 gyratory. The storage capacity is 400 cu.yd., and an adjustable chute permits the direct loading of material into barges.

Power is furnished by two horizontal tubular boilers totaling 200 hp., using soft coal as fuel. These supply steam for one 18 x 24-in. horizontal non-condensing Atlas slide-valve engine, which drives the crushing-plant machinery, and also for the 9 x 9 x 11-in. Chicago Pneumatic air compressor, as well as the pumps.

Under the supervision of the regimental engineer officer, each company operates the quarry for a period of two weeks. The work of the men is changed from time to time, and they are classified and rated according to

*Captain, 28th Engineers.

their aptitude and ability. Individual instruction is given in the care and use of explosives, in machine drilling. tool sharpening, crusher operation, engine care and upkeep, and in boiler firing, the latter with a view to smoke elimination. Cost sheets are kept of operations and posted in both company and regimental offices, a basis of $1.60 per day for privates and $2 per day for non-commissioned officers being adopted. The following costs per cubic yard are for the month of June, 1918, and are based on a total of 2450 yd. shipped, representing about 4000 yd. handled in sorting rock for shipment for road work:

Labor—Stripping, $0.045; drilling, $0.023; loading and sorting, $0.242; crushing, $0.069; power, $0.08; barge and miscellaneous, $0.035. Supplies—Explosives, $0.051; fuel, $0.101, and lubricants, $0.012. Total, $0.668. Four and one-half yards of material was broken to the pound of 40% dynamite used.

A spirited rivalry exists among the companies, each striving for the record in tonnage and cost. This spirit extends to the squads of the individual companies, with a corporal in command. The company commanders were able to classify and distribute their men to the best advantage, so as to be prepared for the more serious work ahead.

Intensive military training has been given the men when not engaged in the quarry, and the regiment is now well fitted to accept any of the responsibilities of an engineer regiment. In fact, as the men perfected themselves in drill, bayonet work and military routine, quarrying became a secondary consideration, the first being a desire to get into the front line trenches and try their skill in "No Man's Land."

California Crude-Oil Prices

The prices of California crude oil at the well in the San Joaquin and the Southern fields, posted on May 1, 1918, and which are uniform in both districts, are the highest paid in recent years in California, and represent a large increase since 1913. In the San Joaquin field this increase ranged from 82c. per bbl. for the highest gravity to 88c. per bbl. for low-gravity oil. The increase in the Southern field ranged from 63c. to 72c. The prices are $1.23 per bbl. for low-gravity and $1.57 for the highest.

In 1913, six prices were named in the San Joaquin field, ranging from 35c. per bbl. up to 75c. per bbl., according to gravity. In the Southern field only four prices were named, ranging from 60c. per bbl. up to 85c. The low-gravity oil in the San Joaquin district was lower than that in the Southern field. The methods of fixing prices are similar in the two districts. In January, 1916, the same range of gravities was maintained, but the prices were fixed for oil above 18° by adding 1c. per bbl. per degree. This method has since been maintained. In September, 1916, the gravities were extended in the San Joaquin field, and in November the extension was applied to the Southern field, providing for an increase of 0.03c. per bbl. per degree for oil of 38° and above. The prices thus announced by the Standard Oil Co. are the ruling prices paid by other marketers and refiners, and are not likely to be again increased during the period of the war.

In the early period of commercial production of oil in California, beginning in 1875, a record of price movements was not kept. But in the period of 35 years to and including 1909 the annual production records are fairly dependable, showing a total production of 309,077,701 bbl., of an estimated total value of $136,693,228. On this basis, the average price during the 35-year period was approximately 45c. per bbl. In the three years following (1910, 1911, 1912), the total production was 252,034,975 bbl., and the recorded value totaled $120,109,974, or an average price of approximately 48c. per bbl. The price in 1909 varied from 45c. to 70c. per bbl., and these figures represent approximately the average movement during a period of about 40 years. Occasionally high prices were paid for high-gravity oil, one record in 1909 showing a price of $1.10 per bbl. But another record in earlier years shows prices as low as 15c. and as high as 75c. for low-gravity oil.

Bounty on Gold Proposed

Improvement of the gold situation was the theme of discussion at the International Gold Conference of the Northwest Mining Association which met in Spokane, Wash., on Sept. 5 and 6. Alaska, British Columbia, Washington, Idaho, Montana and Oregon were represented in the conference. The following resolutions, introduced by Frank A. Ross, mining engineer and vice president of the association, were unanimously adopted by the conference:

Resolved, That the grant of priority rights in the purchase and transportation of materials, machinery and general mining supplies be enforced, and that, as far as possible, such items of expense as taxes and freight rates be restored to pre-war levels;

That the labor necessary to the operation of mines producing gold-bearing ores be assigned to them;

That main lines of motor-truck roads be built from railroad points into the distributing centers of promising but commercially inaccessible gold fields; for instance, such as those of central Idaho; also, that trails or wagon roads connecting with these main roads be opened to promising camps in cases where the routes thereto lie through Government reserves;

That financial aid or credit be extended to such individual properties as may be judged by Government specialists to be capable of producing appreciable quantities of gold or other metals essential to the conduct of the war;

That a bounty be paid upon every ounce of new gold produced by the mines of the nation, the amount of which bounty shall, from time to time, be determined by the proper authorities to be sufficient to encourage the mining of gold-bearing ores by insuring a reasonable profit therein; the said bounty to be considered a permissible war expedient and expense that in no way affects the international, or standard, value of gold.

The bounty on gold referred to in the resolutions was discussed by Mr. Ross in a paper on "The Gold Situation and Its Remedies," in which he suggested ways of insuring that the proposed bounty should reach only those entitled to it. These provided for indentification of those seeking to sell gold; that the metal be purchased only at designated places; that applicants for the bounty present properly certified settlement sheets from the mint, smeltery, etc., that bought their bullion or ores; and that such sheets be certified by Government "inspectors of ore shipments." These inspectors were to be officials having the requisite technical knowledge and experience and appointed as a war measure to represent the Government at the "relatively few public places receiving and buying gold-bearing ores or crude alloys containing gold." The conference was attended by many representative mining men of the Pacific Northwest.

Argentine-Bolivian Petroleum*

BY STANLEY C. HEROLD

Extending from northern Argentine northward into central Bolivia is a belt of petroleum seepages. On account of the remoteness of the district, it has heretofore been little considered by oil operators. The regional geology is comparatively well understood, but the local features have not been carefully detailed. The areas extend in a narrow belt from the north-central part of the Province of Salta, Argentina, northward into the central part of Bolivia. This belt lies in a direction a few degrees east of north, slightly curved, with its concave flexure to the west, passing through the border town of Yacuiva at latitude 22° S and longitude 63° 30′ W of Greenwich. It extends from 18° S to 23° S latitude.

To the west of the field lie the frontal ranges of the Andes system, beyond which extend high rugged mountains, deep, narrow gorges and high plateaus, culminating in the crest of the continental range. Toward the east extends the great expansive plain, reaching over northeast Argentine, southeast Bolivia, northern Paraguay and into southern Brazil. Notable seepages of oil occur in the following political subdivisions of the two countries: Argentine—Department of Orán, Province of Salta. Bolivia—Departments of Tarija, Sucre, (Chuquisaca), and Santa Cruz.

The climate of this region is sub-tropical, with temperature variation between 40° F. in winter and 90° F. in summer. Occasionally more extreme temperatures of 30° and 115° are experienced, though generally for short duration only. The humidity of the summer atmosphere is rather oppressive, and rainfall at this season is heavy. The winter months are rainless, to such an extent that resident natives suffer from lack of good water for domestic purposes.

The terminal at the town of Embarcación, in Argentina, is the nearest approach made by a railroad to the oil region. This road is a narrow-gage line operated under the management of the Ferrocarril Central Norte, connecting the cities of Tucumán, Salta, and Embarcación, with a junction point between the latter two at Güemes. The broad-gage line of the Ferrocarril Central Argentina connects Tucumán with Buenos Aires.

Seepages of oil, and asphalt deposits, have been known to exist in this part of the continent for many years. The native Indians had used oil for medicinal purposes and knew of its inflammability before the arrival of the first Spanish explorers. To this day, small quantities are collected by both Indians and civilized people for domestic use, as it is often of such high quality that it may be used in crude lamps in its natural state. Several springs are persistent in their flow, though they give only two or three quarts, individually, per day. In addition to these, numerous other localities have been reported by competent natives to show signs of oil. These are in creeks crossing the same line, and are said to show oil on the surface of quiet water before the drying-up of the streams. During the dry season the oil can sometimes be detected by odor from fresh soil at these places.

The results of the development attempted in the past have been unsatisfactory, owing principally to lack of sufficient knowledge on the part of the operators concerning the stratigraphic and structural conditions existing in the field. Wells have been placed in localities where there would seem to be no possibility of reaching oil horizons in evidence on adjoining ground, and where local structural conditions are not particularly favorable for the accumulation of petroleum below the surface. Obviously, such wells are unable to give definite proof regarding the possibilities of the field at large, and represent an almost useless expenditure.

Other enterprises have failed on account of financial difficulties, lack of proper organization, or mismanagement. A company intending to work in this field should have sufficient capital to tide it over excessive costs before expected returns. A well of 3000 ft. (914 m.) depth may be estimated to cost between $65,000 and $75,000. Transportation and imported labor are expensive, and delays are frequently due to the large quantity of spare parts necessarily required. Drillers must be carefully selected. Proficiency does not seem to be a more important qualification than personality and adaptability, for in camp the companionship must be agreeable, and modern conveniences are generally absent.

Although thousands of claims have been legally granted by the governments of Argentina and Bolivia, only seven or eight honest attempts have been made to develop various sections of the field. At present, access to the region is somewhat difficult, but no serious problem would be encountered in improving the conditions. The nearest railroad terminal is 114 miles south of the Bolivian border, or 72 miles from the nearest manifestation of petroleum in natural springs.

Native labor is good, and government policies are sympathetic toward foreign exploitation. Though the structural features of the region, as a unit, have been worked out by reconnaissance surveys, there still remain many local sections upon which no detail study has been made. Several small areas have been proved unfavorable for production, though the region as a whole cannot be condemned on this account.

*Excerpt from a paper to be presented at the New York meeting of the A. I. M. E., February, 1919.

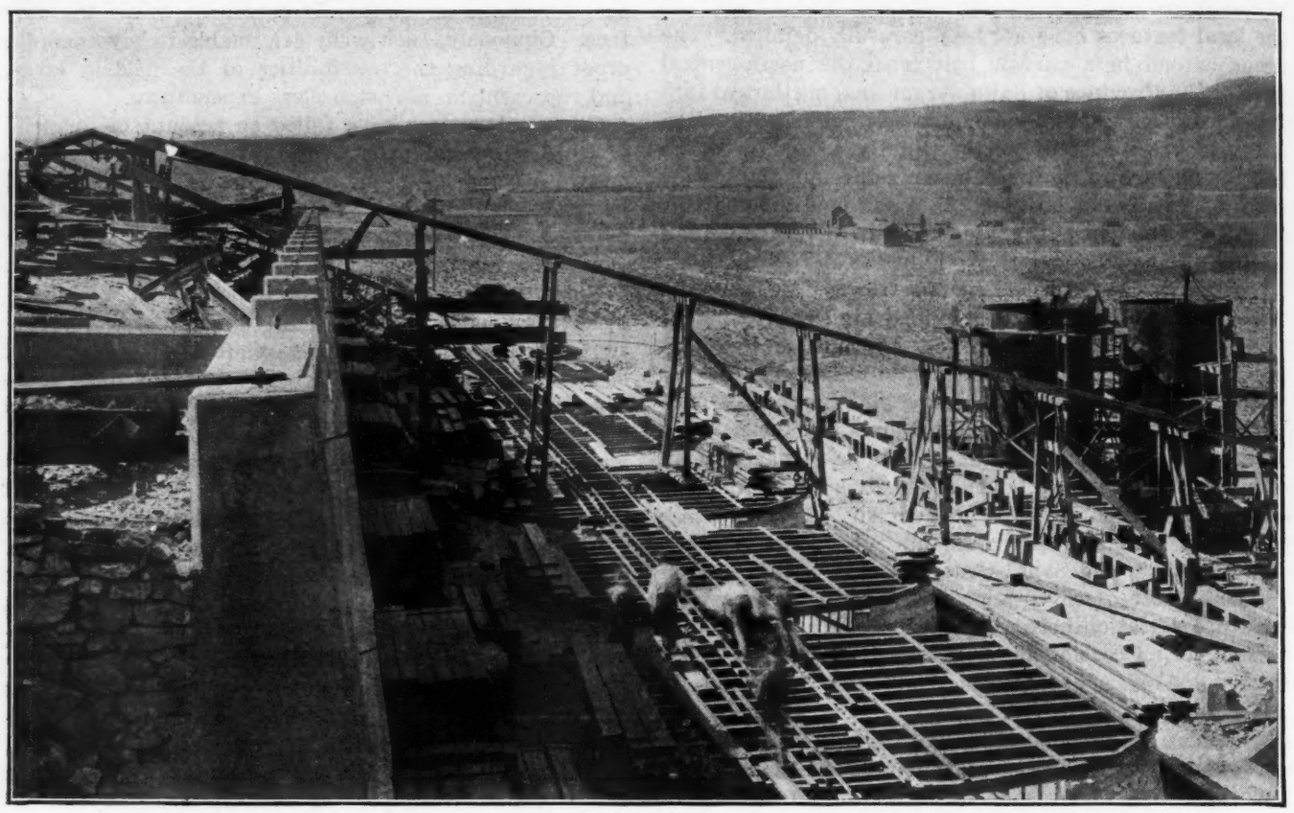
Rights Against Railway Company

BY A. L. H. STREET*

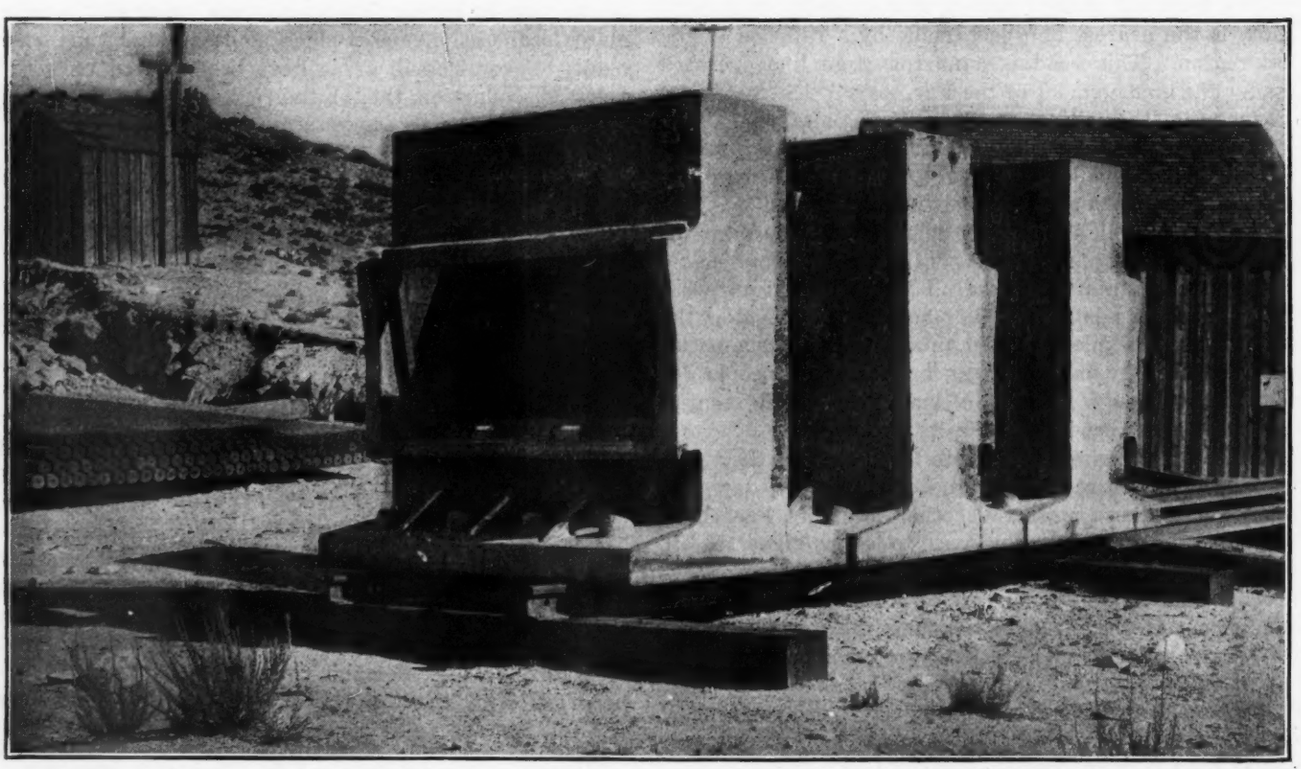
A railway company is liable for the value of ore shipped at the instance of a third person, after being notified by the real owner of his ownership and not to transport the ore, although such third person furnished the railway company with an affidavit that he was the owner. This is the gist of the decision handed down by the Nevada Supreme Court in the late case of Dixon *vs.* Southern Pacific Co. (*172 Pacific Reporter, 368.*) The court holds that the mere fact that a railway company transports property at the instance of one not the owner thereof does not render the company liable in damages to the true owner, but that, where the true owner makes proper demand, any subsequent disregard of that demand constitutes a wrongful appropriation of the property by the carrier, rendering it liable for the value of such property.

*Attorney at law, 820 Security Bldg., Minneapolis, Minnesota.

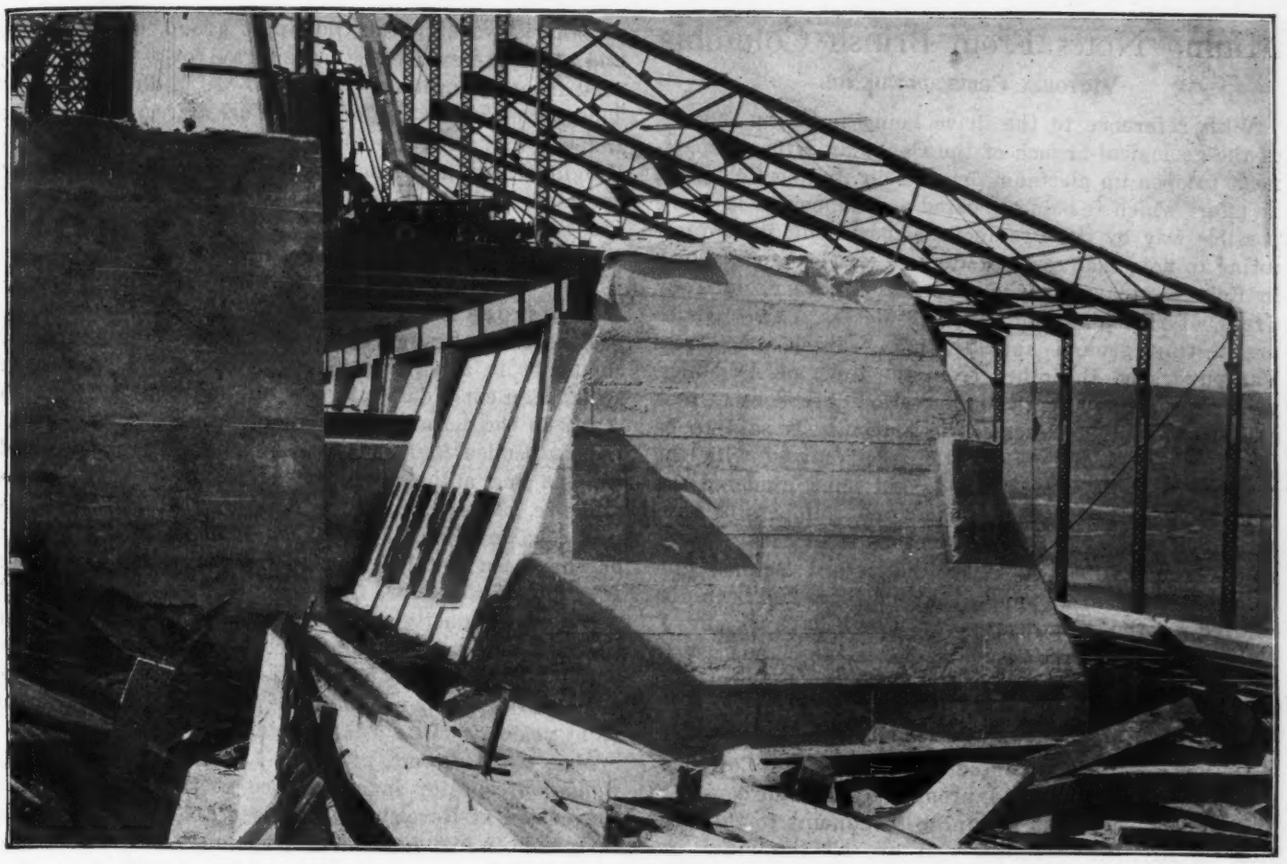
Examples of Mill Construction



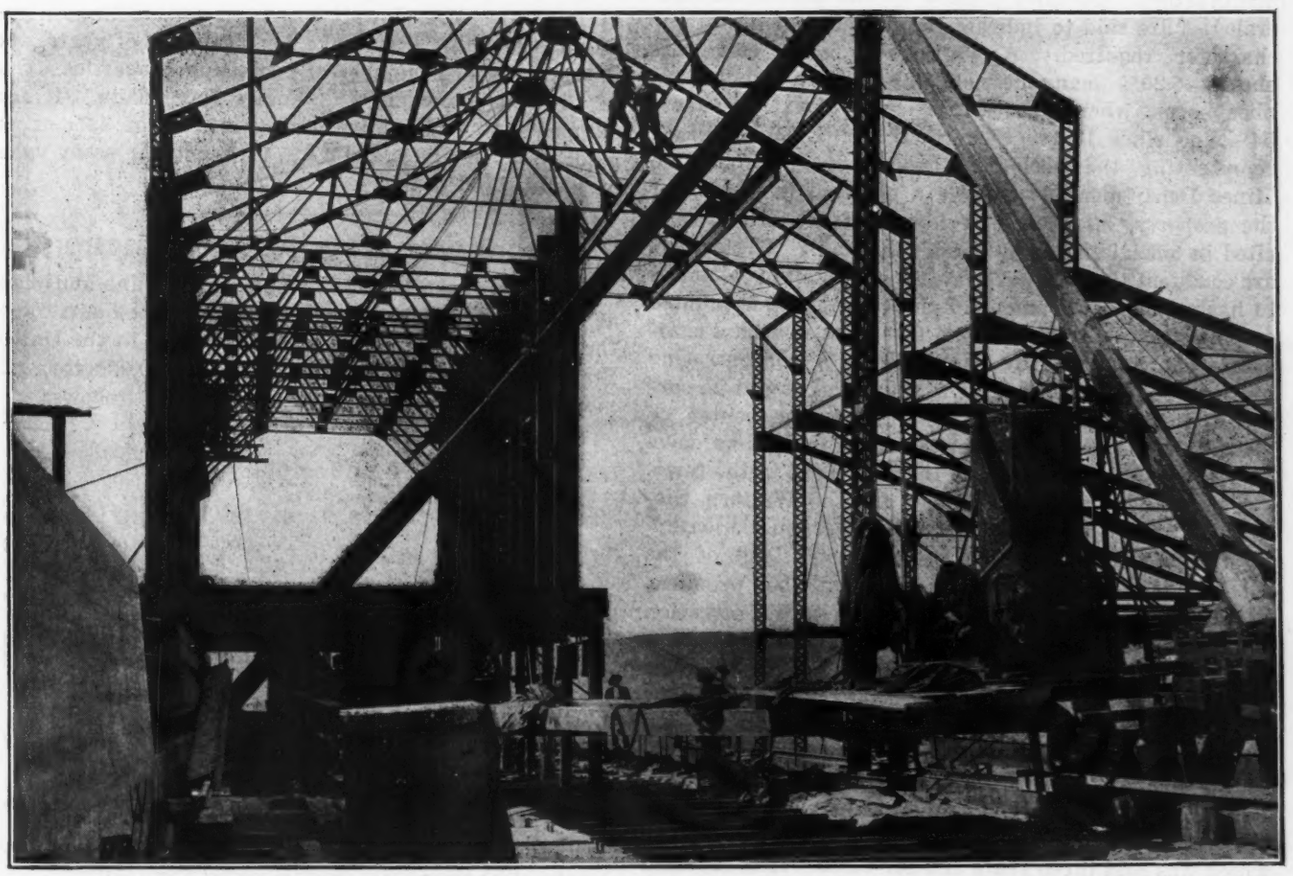
CYANIDE TANKS UNDER CONSTRUCTION AT GOLDFIELD CONSOLIDATED MILL, GOLDFIELD, NEVADA



TEMPORARY STORAGE OF STAMP STEMS AND MORTARS, GOLDFIELD CONSOLIDATED MINES COMPANY



CONCRETE BATTERY BLOCKS AT 100-STAMP MILL OF GOLDFIELD CONSOLIDATED MINES COMPANY



CONSTRUCTING MILL FRAMEWORK AT GOLDFIELD CONSOLIDATED MILL, GOLDFIELD, NEVADA

These photographs, showing portions of the Goldfield mill during process of construction in 1909, will doubtless be of interest as examples of mill construction

Mining Notes From British Columbia

VICTORIA CORRESPONDENCE

With reference to the drive being made by officials of the geological branch of the Canadian Mines Department to open up platinum deposits in British Columbia, an effort which is being assisted and supported in every possible way by the Provincial Department, it is interesting to note that some excitement has been occasioned in East Kootenay by the reported discovery, on Toby Creek, of rich platinum and gold placers. Two parties are testing ground and locating bedrock, one from Vancouver and the other from the town of Athlamer, which is situated at the junction of Toby Creek and the Columbia River. The platinum is said to be found in flakes and as small nuggets mixed with the coarse gold. High water and rain have hindered development somewhat, and, meanwhile, numbers of residents of the district are hurrying to the locality, which is easily accessible, to stake and record claims.

Recent mention was made that platinum had been discovered in the Nome property, Cariboo Creek, by J. Nordquist. The first assays made, if the claims are to be credited, showed the presence of the mineral, but samples sent to the provincial analyst failed to disclose platinum.

Discoveries of manganese deposits in the Cowichan district, Vancouver Island, promise to prove of considerable importance, from a mining standpoint to this section of British Columbia, and are all the more important because manganese is essential in munition manufacture. Samples treated by the provincial mineralogist are said to indicate the presence of ore of the character required. A Vancouver firm's certificate shows 46.20% manganese, 26.92% silica, and 0.064% phosphorus, whereas a Seattle assay gives manganese 54% and silica 18.4%. The fact that G. C. McKenzie, representing the geological branch of the Canadian Mines Department, is making a personal inspection of the property, is taken as evidence of the interest excited in official circles by these valuations. The owners are confident that the government will do all in its power to hasten the development of the claims. It is pointed out that the ore, to judge from assays, is of such a character that it can easily be handled. A concentrating mill will be needed. This, it is suggested, might be constructed in a short time at Duncan, the center of Cowichan, the ore being shipped from the claims down Cowichan Lake by water and thence by rail to the town.

The resident mining engineer for the Western District of British Columbia, W. M. Brewer, speaks enthusiastically with regard to present conditions of the mining industry in this section of the province. Some of the activities that have come to his attention are thus summarized: The Phelps Dodge interests have taken bonds on the Fraser group (East Sooke); the Ladysmith Smelting Corporation has bonded the Willow Grouse, Cowichan Lake; and the Sunlock Mines, Jordan River, are being run by Patrick Stewart for a Vancouver company. In the Alberni Canal region, Samuel Ryder, of St. Albans, England, has installed new bunkers and a compressor plant at the old Monitor mine, which was sold three years ago for taxes. It is reported that a large body of ore has been blocked out. At Quatsino Sound, also Vancouver Island, the Coast Copper Co. is working the Old Sport group, on Elk Lake, and plans are said to be under way for a 16-mile railroad from the mines to the coast. At Sidney Inlet, the Tidewater Copper Co., of New York, is working on the Indian Chief group, a former Dwedney holding, and at Knights Inlet the Princess and Union groups are being operated. Work is proceeding on the Texada Island properties, and prospecting forces are working everywhere, particularly on Hervis Inlet.

The Canada Copper Corporation is making satisfactory progress in the development of its immense deposits of low-grade copper at Copper Mountain, and should be in a position to begin production on a large scale at an early date. It is estimated that before work starts in the actual taking out of ore, the company will have expended $3,000,000. Miles of road for the use of wagons and automobile trucks have been built to the mill site, situated four miles from Princeton; and a sawmill capable of cutting between 16,000 and 18,000 ft. a day has been installed. Some excavating has been done for foundations for the concentrating plant, which will have a capacity of 2000 tons daily; and some of the timber to be used in construction work has been prepared. The company has been engaged in the development of its Copper Mountain properties for seven or eight years.

Mrs. A. E. Jowett, of Trout Lake, who was the only woman prospector in attendance at the recent mining convention at Revelstoke, has been able to demonstrate that, even in a rugged country such as the Kootenays of British Columbia, a member of the fair sex can successfully locate, record, and arrange for the development of mineral. Mrs. Jowett has been prospecting in the neighborhood of Trout Lake for a number of years, and is the owner of a number of promising properties. One of these is known as the Foggy Day Claim. It has shipped nine tons of ore giving returns of 4.29 oz. in gold, 16 oz. in silver, and 4.6% lead, with an assay value of about $100 a ton.

Labor for Magnesite Production

The Northwest Magnesite Co., with a mine and plant at Chewelah, Wash., produces about three-quarters of the magnesite used by the steel companies in the United States, and is capable of an output of 10,000 tons per month. The employees are classified as follows:

Classification:	Number
Superintendents	2
Clerks	6
Watchmen and janitors	5
Crushermen and helpers	16
Laborers	80
Conveyormen	8
Weighers	7
Teamsters and truckmen	2
Burners and helpers	12
Coal operators	7
Chemists and helpers	2
Electricians and helpers	4
Carpenters and helpers	12
Blacksmith and helpers	9
General mechanics	5
Foremen	6
Compressormen	2
Miners	10
Muckers	70
Samplers	1
Trammers	8
Timbermen	2
Tramway operators	15
Total	291

Previous to the war practically all the magnesite used by the steel companies was imported from Austria.

Remember the Comfort Fund of the 27th Engineers.

Your Part

By Berton Braley

YOU can't do too much for your country, no matter how much you may do;
The soldier who fights in the trenches is doing enough, but for You,
For you and for me and the others who live here in safety at home,
Our burden is light to the burden of fighting men, over the foam.
We can't do *enough* in proportion to what they're accomplishing there,
But we *can* do our best and our finest, we *can* do our ultimate share.
And that means to toil and endeavor, to sacrifice much that we crave,
To speed up our task and be cheerful, to hold down our outgo—and save!

YOU can't do too much for your country, but why not do all that you can?
Your job is a part of the conflict—you fit in the general plan;
And less than your best is disloyal, it means that you're slacking your part,
When all of your powers are needed, of body and brain, and of heart.
Then, when you have given your utmost of thinking and toiling and sweat,
You still have a duty to finish, the end of your task is not yet.
Dig down, till it hurts, in your income; dig up, till you're broke—and beyond;
You can't do too much for your country, you can't save too much for a bond!

THIS isn't a question of "almost," or "just about," "nearly," and "quite";
Your *all* is the least that is needed to win in this world-shaking fight;
Your all of achievement and effort, your all of possessions and cash,
To build up the might of the nation and strengthen its thews for the smash.
The smash that shall conquer the Teuton—your all is the least you can do!
The limit of human resources is needed *now,* brethren—come through!
Come through with your uttermost service, with every last cent that you own;
Go over the top with your labor—and over the top with the Loan!

Essential and Non-Essential Employees

The vexed question of the status of an employee in an industrial organization—his replaceability or irreplaceability without positive detriment to output—is dealt with in a pamphlet issued by the Northwest Magnesite Co. to its workmen, which certifies the classification of the bearer. Information in relation to various employments is also given, and the data are arranged so that the draft board, or other official body concerned, may have authentic facts regarding the specialized work being performed by certain employees, and may be able to judge as to how the interests of the country may best be served by avoiding unnecessary dislocation of industry, and by exempting from service those who are really indispensable.

The company has developed a property at Chewelah, Wash., and erected a plant, the capacity of which is 10,000 tons per month. The product—magnesite—is used almost entirely in steel manufacture, and is therefore essentially a war material. The employees are classified into 23 groups, and comments are made as to their individual value in the industry.

Superintendents

The plant was designed and erected without the suggestive assistance of precedent or example, there being no installation in the world producing an article under the same conditions. The general superintendent has been in constant touch with operations, and could not be replaced without seriously imparing production. The mine superintendent is the only man in the United States qualified intelligently to mine magnesite, and his continuous training since the property was discovered gives him the necessary knowledge of the character of the rock. It is felt that his loss would seriously affect the industry and that he could not better serve his country than to continue to act in his present capacity.

Clerks

A chief clerk and three assistants are required, two men and two women. It is not possible to employ women exclusively, and it is therefore essential to maintain the organization as it now exists. The chief clerk is considered essential.

Watchmen and Janitors

Any one employed by this company under this classification may be replaced without seriously interfering with production.

Crushermen and Helpers

These men are employed in two grinding mills reducing the raw ore to the proper size. The head crusherman and helpers are essential, require special training and would be difficult to replace.

Laborers

The laborers employed at the mine and at the reduction works are a migratory class, and a certain number are essential to efficient operation. The character of the work which they perform is not skilled, and they may readily be replaced from whatever common labor supply may remain in the United States after drafts are completed. The plant is operated automatically wherever machinery can be employed.

Conveyormen

These workmen are employed in connection with the conveyors which are used in transporting the rock through the various treatments. By having men qualified to maintain these conveyors, the necessity for other labor is eliminated. A conveyorman may be classified as semi-essential to the business, for the reason that if other labor is available it can be trained in a few days to understand the work.

Weighers, Teamsters and Truckmen

Certain men are required to weigh material continuously, and this work requires only ordinary ability. Teamsters and truckmen are essential, and this work should be done by men over draft age.

Burners and Helpers

Burners and helpers are essential to operation and require long experience in order to be able properly to burn the material and to manufacture the finished product.

Coal Operators

The burning of powdered coal in the kilns is essential. The powdered-coal plant contains complicated machinery and requires mechanical knowledge and training in order to operate it successfully.

Chemist and Helpers

A chemist and an assistant are employed, and they have for the last two years been daily analyzing magnesite. These chemists, on account of their experience, are probably the best qualified in the United States to analyze magnesite.

Electricians and Helpers

Three electricians, one on each shift, are employed in the operation of the power plant and the maintaining of a 1500-hp. installation of small motors. There would be great difficulty replacing them, because any interruption in power causes the idleness of the remainder of the labor.

Carpenters, Blacksmiths, and Helpers

Carpenters may be obtained from men over the draft age. A blacksmith and helper are essential, but may also be obtained from men over the draft age.

Mechanics and Foremen

A few special mechanics are employed who are thoroughly familiar with the plant and would be hard to replace. The foremen are next in importance to the superintendents, as they have been employed since the beginning, and their familiarity with the process makes them invaluable. They cannot be replaced by any other men, as no one else is familiar with the manufacture of this material as it is being made by this company.

Compressormen

These employees operate the air compressor, and though essential to the industry, it is felt that men over the draft age should be employed.

Miners

On account of the great scarcity of miners in the United States, due to the fact that many of them have

already been drawn into the active service, it has been impossible to obtain sufficient men of this class. They are absolutely essential.

MUCKERS

The muckers who are working at the mine are practically ordinary labor, and most of them are over the draft age. There is an insufficient supply.

SAMPLERS

Owing to the fact that the deposit in this district is the only one of its character in the United States, special samplers have been trained, who are qualified by long experience to tell by sight the character of the ore required. These men cannot be replaced without long training and serious loss to the industry.

TRAMMERS AND TIMBERMEN

Trammers are laborers. There is an insufficient supply of this class of labor. Timbermen are a trained class qualified to timber a mine and protect the lives of their fellow workers. The supply is insufficient.

TRAMWAY OPERATORS

These men are occupied in the operation of an aërial rope tramway, and should be placed in the same class as railroad operators. They are essential to the industry.

It will be noted that, of the number of men required to operate the property, certain are essential, whereas others may be drawn from the labor supply that remains after the draft has been completed. The company expects to share in the inconvenience and strain which will be caused by the draft; and the information given is intended as a guide, and should not be construed as a plea for exemptions, other than in the case of those who, on account of their experience in an industry hitherto unknown in the United States, may well be allowed to remain in their present occupations.

John C. Greenway a Lieutenant Colonel

When John C. Greenway, the former manager of the Calumet & Arizona Mining Co., left Arizona for France a year ago, he went as a major of engineers, but he is now a lieutenant colonel of infantry. Lieutenant Colonel Greenway only recently received his promotion, and it was at his own request that he was transferred to another branch of the service. The *Arizona Republican* has recently published a sketch of Colonel Greenway's career, in which it says:

"He won his promotion by fighting in the hottest battle of the front when the German horde was turned back below Chateau Thierry. He is the most distinguished Arizonian in the war. When the Spanish-American War broke out, Mr. Greenway, already established in a promising career, dropped everything, joined the Rough Riders, and so bore himself as to be given distinguished mention in Colonel Roosevelt's book on the Cuban campaign. He retired at the end of the war with a captaincy.

Captain Greenway resumed his work, and seven or eight years ago became the most efficient general manager of the Calumet & Arizona Mining Co. At the time America entered the conflict, Captain Greenway's responsibilities as general manager were heavier than ever. He was developing the great Ajo district. But there was no position in the country, whatever its need of him or its allurement for him, that could have held him.

"Colonel Greenway is not a seeker of adventure; only a doer of what he sees to be his duty. He is as honest as he is courageous and American. Soon after he became general manager of the Calumet & Arizona, the name of "Dividend Johnny" was applied to him because of his highly successful operation of that property.

"During his direction of the operations of the company it was only twice subjected to strikes. One occurred at Ajo a couple of years ago, an I. W. W. agitation. The other was at Bisbee a year ago last summer.

"The mining interests 'über alles' was never the slogan of Colonel Greenway. If the mining interests were in his opinion right, he was with them, but if he believed their claims to be unjust, he withdrew from them. He always worked in the open. Friends and opponents never had to indulge in conjecture as to where Greenway stood. He was loyal to his friends and his affiliations, but he was always his own man."

Fluorspar Output Estimated for 1918

The production of fluorspar in 1918 is estimated by the U. S. Geological Survey at 100,000 short tons for the first half and 118,000 short tons for the last half, the total for the year being 218,000 short tons. The amount as estimated is considerably less than it might be if sufficient labor, machinery, and other supplies were available. The shipments for the first half of 1918 are estimated at approximately 108,000 short tons, and there were about 10,560 tons of spar in stock at the mines, only about 2000 tons of which had not been sold or contracted for on July 1, 1918.

Shipments of spar from the mines in 1917 were 218,828 short tons, valued at $2,287,722, an average price of $10.45 a ton, compared with 155,735 tons, valued at $922,654, or $5.92 a ton, in 1916. This represents an increase in total tonnage of 40.5% and in total value of nearly 148%. The quantity of crude fluorspar mined in the United States in 1917 reached a total of 280,825 short tons, compared with 175,165 tons in 1916, an increase of more than 60%. The stocks of marketable spar on hand at the end of 1917 amounted to 21,655 short tons, compared with 3666 tons at the end of 1916, but a considerable part of this stock was under contract, awaiting cars, boats, or weather favorable for shipment.

The demand for fluorspar may be said to be governed mainly by the openhearth steel industry, so that supplies that are within reach of steel-making centers are certain to be drawn on heavily during war times. Mines in all producing states except Arizona reported an exceptionally heavy demand during 1917, and the high prices stimulated prospecting and led to the opening of many hitherto unworked deposits of fluorspar in Illinois, Kentucky, and Colorado.

Diamond Exports from Amsterdam to the United States totalled $1,419,800 in value for the quarter ended June 30, according to the Department of Commerce.

Notice to All Distributors, Converters, and Users of Paper and Paper Products

It contains sulphur needed for war munitions.

War Industries Board

PAPER IS ESSENTIAL: It has been placed on the priority list only on the express condition that all wastes be eliminated and every economy be practiced. In doing this the Government will use its best efforts to provide sufficient paper for strictly needful purposes but nothing more. Every distributor, converter, or user of paper is hereby notified that the continuance of his supply is dependent entirely upon the strict observance of the rulings of the War Industries Board, one of which is that paper must not be wasted. Failure to comply with this requirement will lead to the withdrawal of any or all priority privileges, without which the supply cannot be maintained.

WAR INDUSTRIES BOARD

A pound of paper saved saves three pounds of coal. Save waste paper but don't waste paper.

War Industries Board

Seven Reasons Why Paper Must Not Be Wasted

1. The Government's requirements for all kinds of paper are increasing rapidly and must be supplied.

2. Paper making requires a large amount of fuel which is essential for war purposes. A pound of paper wasted represents from one to three pounds of coal wasted.

3. Paper contains valuable chemicals necessary for war purposes. Economy in the use of paper will release a large quantity of these materials for making ammunition or poisonous gas.

4. Paper making requires labor and capital, both of which are needed in war service.

5. Paper making requires transportation space. Economy in the use of paper will release thousands of freight cars for war purposes.

6. Greater care in the purchase and use of paper will save money. Your savings will help finance the war.

7. Strictest economy in the use of paper will prevent a shortage. —*War Industries Board.*

The Necessity for the Conservation of Paper

(An amplification of the eight reasons why paper should not be wasted)

I. *General Survey*

PAPER is the most generally used of all articles except food and probably the most shamefully wasted. Prior to the war there was an abundance of paper, prices were low and people paid little attention to economies in its use. Our entrance into the war has completely changed conditions. Some of the materials used in making paper, such as pulp wood, sulphur, bleach, etc., are growing scarcer, and the costs of materials and also of labor are increasing rapidly. The paper industry, not being a strictly war industry, must transfer to the war industries as much of its labor, coal, sulphur, bleach, and transportation space as is necessary to win the war. This means that the production of paper will be considerably curtailed as the war goes on. On the other hand, the Government is becoming a much heavier purchaser of paper and paper products than formerly.

II. *Increase in Government's Requirements*

The various new branches of the Government, organized as a result of the war and the expansion of the regular departments and commissions, have greatly increased the demand for all kinds of office and commercial stationery such as writing paper and envelopes. Recently the War Department has asked for one billion envelopes in addition to its regular requirements. Then there are the demands of the Food and Fuel Administrations and the Liberty Loan and War Stamp Divisions of the Treasury Department and the Red Cross for their posters and other campaign literature.

The Ordnance and Quartermaster's Departments, either directly or indirectly through the private concerns under contract with them, are buying rapidly increasing quantities of paper boxes and containers and strong wrapping paper for shipments of munitions, foodstuffs, and other supplies for overseas. They are also taking practically the entire output of plaster-board mills for the construction of camps, hospitals, etc. A large quantity of Bristol-board index cards is being used for registering drafted men, and recently the Quartermaster's Division contracted for all the lightweight toilet tissue that the mills could make in the next sixty days.

The war has led to an extensive substitution of paper products for those formerly made of wood, tin, etc. Paper containers are now displacing wooden boxes and tin boxes on account of the scarcity of these materials, and paper bandages and absorbent packs are rapidly taking the place of cotton for doing up wounds. Paper has also been found most satisfying for making gas masks. The fact is that almost every day the Government finds some new use for paper in connection with its war program.

III. *Consumption of Fuel*

The Paper Industry is a large consumer of fuel. On the coarser grades of paper one ton of coal is consumed on the average for each ton of paper produced, while on the finer grades two or, in some cases, even three tons of coal are consumed for each ton of paper. Estimating the total production of paper during the year 1918 at 6,000,000 tons, the consumption of coal would be from 8,000,000 to 10,000,000 tons. In addition a large part of the coal consumed by the Canadian paper industry comes from the United States.

A saving in the consumption of paper of 25 per cent would mean the release of nearly 2,500,000 tons of coal for war purposes, together with the car space required to transport this tonnage. It is conservatively estimated that there will be a shortage of coal this year of from 50,000,000 to 60,000,000 tons.

IV. *Consumption of Chemicals*

Most of the chemicals used in paper making are also indispensable for making ammunition and poisonous gases. The scarcity of sulphur has recently forced the Government to take over the two mines in Louisiana and Texas in order to assure itself of an adequate supply for war purposes. Present indications are that there will be enough sulphur allotted to the paper industry to manufacture the paper actually needed, but the Government cannot supply sulphur to be made into paper that is wasted.

The same situation exists with respect to chlorine. In order to break through the German lines with a minimum sacrifice of the lives of our boys the Government must greatly increase its production of poisonous gases. Chlorine is indispensable for this purpose, and the people may be called upon to dispense entirely with white paper, bleached with chlorine, in order that the Government may increase its supply.

Caustic soda is another valuable chemical needed for war purposes and also used extensively in paper making. The problem facing the Government now is how it can make up a shortage of 80,000 tons. If all wasteful and unnecessary uses of paper are eliminated, some of the shortage can be made good.

V. *Consumption of Labor and Capital*

The pulp and paper mills of the United States employ about 90,000 wage earners, practically all males, and require a working capital which probably exceeds $150,000,000. Merchants, jobbers, and other middlemen, together with the converters or manufacturers of paper products, represent a much larger number of wage earners and a much larger working capital. The paper industry, like other nonwar industries, must contribute whatever proportion of its labor and capital is necessary to win the war. This means that no labor or capital can be spared to make paper or paper products that are not absolutely necessary.

VI. *Consumption of Transportation Space*

It is estimated that about three tons of materials on the average, in addition to coal, are consumed to produce a ton of paper. This includes the tonnage represented by the pulp, waste-paper stock, repair parts, etc.

We have then a demand by the paper industry for something like 25,000,000 tons of freight that has to be moved annually. This represents nearly a million carloads required for the original manufacture and distribution.

A large part of the paper produced is converted into various articles which have to be transported again. For example, news print and book paper are converted into newspapers, magazines, books, etc., many of which are sent through the mails as second-class matter. Paper board is converted into folding boxes, set-up boxes, corrugated and fiber containers, and these are delivered to the concerns using them, filled with the various articles, and again shipped to the wholesaler, retailer, or the ultimate consumer. Paper is converted into stationery, envelopes, tablets, into drinking cups, towels, wearing apparel, and a thousand other forms, and in each case a further shipment usually takes place. Any economies effected are, therefore, cumulative in respect to the transportation space saved.

A reduction of 25 per cent in the consumption of paper would release 6,000,000 tons of freight in and out of the mills in addition to the 2,500,000 tons of coal. This represents 400,000 carloads. The surplus car capacity not needed for the shipment of munitions, food, fuel, and Government supplies is now not over 10 or 15 per cent and is steadily decreasing.

VII. *Waste of Paper Means Waste of Money*

Paper is a valuable commodity and its cost is increasing steadily. Every pound of paper wasted represents the waste of money that might better be used to help finance the war, or to help the Red Cross or Y. M. C. A. The aggregate saving that could be realized by the more careful purchase and more economical use of paper would be enormous.

VIII. *Importance of Preventing Shortage*

Paper is an article of such general and necessary use that if a shortage were allowed to develop it would inevitably lead to serious consequences. The efficiency of the agencies for the dissemination of news, such as newspapers, magazines, trade journals, books, etc., would be impaired. The transaction of business, which depends so largely upon paper, would be interfered with.

In order to avoid the possibility of such a shortage several important steps have already been taken.

1. The Priorities Committee of the War Industries Board has placed all pulp and paper mills on the preferred list with the express understanding that every economy shall be practiced.

2. The Pulp and Paper Section of the War Industries Board has issued rulings affecting all the principal grades of paper which will result in eliminating wastes and increase the productive capacity of mills. The standardization of weights, sizes, colors, etc., will enable mills to run their machines more continuously than heretofore. This will make possible a larger output with the same equipment, working capital, and labor force.

By standardizing products in this manner mills and distributors will be able to confine their stocks to the essentials, thereby increasing the rapidity of their turnover and the efficiency of their working capital. The stocks which wholesalers and retailers are now obliged to carry can undoubtedly be very materially reduced by this means. The consuming public may be slightly inconvenienced in some cases by not being able to purchase just the same article that they formerly bought, but every patriotic citizen should be glad to make the small sacrifice in order to help win the war.

3. The Pulp and Paper Section has also adopted recommendations for curtailing the consumption of paper by newspapers, magazines, trade journals, textbook publishers, etc., which should result in the saving of from 15 to 25 per cent.

What now remains to be done is for every consumer of paper from the housewife and corner grocery or drug store to the large bank, department store, or business house to reduce the consumption of paper to that which is strictly necessary. A prompt and whole-hearted response to the Government's appeal to economize in the use of paper will remove the possibility of a shortage and help materially to win the war.

Every consumer of paper must realize that the failure to observe this requirement may result in the withdrawal of any or all of the priority privileges, without which the supply cannot be maintained.

The Importance of Saving Waste Paper

WASTE paper of all kinds can be used in making new paper or paper boards. All the chip board from which ordinary pasteboard boxes are made is manufactured out of mixed waste paper scraps gathered up in the stores and other places. Newspapers make a better grade of board known as news board. Strong wrapping papers mixed with sulphate pulp are used in making test or strong chip board from which shipping containers of all kinds are made. These are taking the place of wooden boxes, thereby conserving the forests.

The fewer grades of waste paper such as old magazines, books, stationery, etc., are sorted out, deinked, and used again in making books, writing and other grades of paper. In making boards and ledgers, etc., a considerable quantity of rags are necessary, the supply of which is becoming very scarce. It is imperative, therefore, that all old rags be saved. Every household should save all of its old paper and rags as well as old rubber, leather, etc., and dispose of them to the school children, Salvation Army, junkmen, or other collectors, so that the supply may be kept adequate to meet the demands of the Government and other essential uses.

Why You Should Save Paper

SULPHUR is used in the manufacture of practically all kinds of paper.

It is used in the form of SO_2, or Sulphur Dioxide.

Our Government needs great quantities of sulphur for war munitions.

Much of this is used in the manufacture of gas to be used in warfare.

Germany began the use of poison gas in warfare.

It is necessary to fight back with the same weapon.

Otherwise our soldiers will be needlessly sacrificed.

Our Government has beaten Germany at her own game.

We make a better gas, one that is deadlier and drives back the enemy more efficiently than any gas they have.

There must be no shortage of sulphur because every pound of it made into gas saves our own men and helps speed up our final victory.

Every piece of paper contains a certain amount of sulphur.

There are only two sulphur mines in America.

There is not enough sulphur for both the great quantities of gas needed and the tons of paper that we thoughtlessly waste.

Every sheet of paper, every bag, every bit of wrapping paper, every sheet of letter paper we save by not needlessly using or by not thoughtlessly wasting allows just so much more of the precious sulphur for our war use. Save the paper and help choke the fiendish Hun at his own choking game.

How Economy in Paper Helps to Gas the Hun

EARLY in the war the Germans, with fiendish delight, invented poison gas and killed many brave British and French soldiers.

German newspapers said: "We are the greatest chemists in the world. We will win the war with our science."

It became necessary for the Allies to use gas, to even up matters.

Not long after we got into the war our chemists beat the German chemists at their own game. Our chemists have made gases for use in war that are far superior to the German-made brand.

Not long ago we put 500 Germans out of the fighting with one dose of our new gas. German army reports admitted that it was a deadly gas and more efficient than their own. Their boasted skilled chemists are unable to find out how to make it.

But all the world knows that one of its bases is sulphur.

There are but two sulphur mines in this country, one in Louisiana and the other in Texas.

In every sheet of paper that is made there is a certain amount of sulphur.

We have for years been wasting our paper.

There is not enough sulphur available to make all of the gas we want in carrying on our fighting against the inhuman Huns and to also make the usual amount of paper.

We can get along with at least one quarter less paper than we now use.

Every time you economize in paper, every time you do without a sheet of letter paper or a sheet of wrapping paper or paper bags—every sort of paper in fact, you are saving just so much more sulphur for our Government to put into war gases.

The more of this powerful gas we have at the battle front the more of our boys' lives we save and the quicker we will win the final victory.

Do not waste a scrap of paper.

Do not use any paper unless it is absolutely necessary.

In this manner everyone, from the smallest child to the oldest person, can help win the war.

Correspondence and Discussion

Alleviation of Gold-Mining Conditions

Observing a statement in the *Journal* of Sept. 7, 1918, to the effect that the committee which has undertaken to ascertain the increase of cost of gold production is experiencing difficulty in obtaining data from producers, I would like to point out:

1. It is extremely difficult to furnish, from mine accounts, data which shall not be inaccurate, or at all events misleading.

2. The form of questionnaire sent out is not well adapted to elicit the facts concerning the operations of a large proportion of mines which produce gold in ores and concentrates sold to smelters, as distinct from gold bullion.

Mine accounts are based on the actual facts of operation, and, therefore, do not show costs for successive years under similar conditions which would permit fair comparison. The manager's primary object is not to obtain equivalent cost data, but to operate at a maximum profit, if profit is attainable; and, if not, to reduce the loss to a minimum. When faced by conditions such as have existed during the last two years, he is compelled, in order to make both ends meet, to adopt many expedients which reduce costs temporarily at the expense of ultimate loss. In fact, he curtails his expenditure by drawing indirectly on capital, in some form. If he does not resort to such expedients of his own volition, pressure from directors and stockholders soon compels him to do so; for there are few companies which will, or can, operate mines continuously at a loss.

But for the resource mentioned, few gold mines would be in operation today. It is well known that the average percentage of increase of cost in other mines which can increase the selling price of their products, and therefore are not compelled automatically to limit their costs at all hazards, has been far greater than the profit margin of any but a few exceptionally fortunate gold mines. Moreover, in gold mines, which usually exploit veins or other narrow or discontinuous orebodies, the increase in costs, other things being equal, will tend to be relatively greater than in base-metal mines. A large proportion of the expenditure is for labor or explosives, and a smaller proportion for power.

The directions in which most gold-mining companies have been compelled to try to reduce expenses include: (*a*) Concentration of production on the richest or most cheaply worked orebodies; (*b*) reduction of development cost; (*c*) reduction of maintenance expenses; (*d*) use of old stores purchased at pre-war prices, and failure to replace them at present prices; (*e*) suspension of all expenditure on investigation and experiment; and reduction of staff.

I know that all these methods of reducing costs are likely to be practiced, for I have had to adopt them myself. Probably there are many other expedients besides those enumerated. All may be justifiable, even necessary, under the conditions; none show in the accounts; and yet it is certain that every one of these forced economies is made at the expense of the ultimate value of the mine, i.e. it is made out of capital. The statements furnished to the committee will not include them; and it will be difficult to establish their precise amount; yet they represent, in most cases, a large addition to the working costs, and should be fully taken into account if it is desired to ascertain the true rate of increase.

In case it should be represented that (*d*) should figure in the accounts, I may explain that few, if any, mines keep storehouse accounts of material in use. I myself, for instance, have not purchased a pound of new drill steel, or a foot of new rail, during the last two years, but have drawn on old stocks of other material, or used and re-used it to the utmost possible extent. The reduced scale of working, enforced by scarcity of labor, has made it easy to dispense with purchases of materials at the rate heretofore usual.

The process above outlined, however, cannot go on forever. The acute danger of the situation is that mines are getting down to where they can no longer resort to such expedients. My own conviction is that a large proportion of the mines in this state are reduced to a situation where they *must* spend more on development and maintenance, *must* have new stocks of supplies, etc., or go out of business altogether. I need hardly explain to readers of the *Journal* that, in most cases, mines which shut down now will never reopen, or will reopen only after a wasted expenditure of capital, in comparison with which the subvention from the Treasury, required to keep them in existence now would be relatively small. In other words, I am convinced that the general situation of gold producers is far more critical than the figures of output indicate; and that relief, to be effective, should be prompt.

One further point. Opinions expressed editorially in the *Journal* suggest that it is only the mines which produce gold without silver or base metals that should receive assistance. Nothing could be more mistaken. The latter class of mines are those which depend entirely on smelters and railroads. Smelting and freight charges have been greatly, and perhaps justifiably, increased; so that most of the increase in the value of the associated silver, lead, or copper has already been absorbed. Bear in mind that, for the miner, smelting and freight charges are a first charge on his products, and he must meet his expenses and make his profit (if any) out of the balance. I know many cases in which the increased rates have left nothing at all for the actual producer, who is, therefore, in a relatively worse condition than his confrère who produces gold as bullion from amalgamation or cyanidation. A visit to Gilpin County would provide a forcible object lesson as to this point.

GEORGE E. COLLINS.

Denver, Colo., Sept. 16, 1918.

Virginia and the Manganese Shortage

Virginia has more known deposits of manganese than any other state in the Union and more localities have been worked and more manganese has been produced than in any other state. Deposits of manganese occur in the Costal Plain, Piedmont, and the Mountain (Valley) districts. The production of the Costal Plain area is comparatively small, and only a few deposits have been worked. Those near City Point, in Prince George County, are the most prominent, although only a small production may be expected from this field. Workable deposits of manganese have been found in Albemarle, Amherst, Appomattox, Buckingham, Campbell, Nelson, Pittsylvania and Spotsylvania counties, in the Piedmont area. Some of the mines in these counties are yielding a considerable amount. They have been operated for many years and are now in a favorable position to double their production in a short time. The Mountain (Valley) district includes the valley proper, and the area west of the valley known as Appalachia. The principal ore belt lies along the western base of the Blue Ridge Mountains and has a length of 300 miles. The 13 counties in this belt have all produced manganese, the famous Crimora mine having shipped more than all the other mines in the United States combined. Another heavy producer in this district is the Kendall and Fleck mine, situated near the town of Elkton.

Capitalists have been slow to investigate the possibilities of large and speedy profits from sound investments in the manganese industry. This may be caused by the fact that often a few would-be miners with no knowledge or experience in mining have come to Virginia, purchased for a song what they considered a manganese deposit, and then proceeded to develop the property. Frequently this "development" consists of erecting an elaborate mill before a ton of ore is in sight, and after spending all they have and can borrow, the operators return to their starting point complaining that "there is nothing in the manganese industry." It may be well to state in this connection that a few hundred dollars paid to a reputable mining engineer to examine the proposition would be money well spent. The larger investors would not think of operating a manganese mine without an engineer, any more than would a banker consider treating his family for typhoid. But not infrequently, business men, after making a financial success in their particular line, seem to think they are competent to attempt anything.

Recently a group of bankers requested me to examine a property on which they had spent over $30,000 in "development." As soon as I reached the property I saw that they had practically thrown their money away, whereas $15,000 spent in the right direction would have put the property on a dividend-paying basis, for there was no question as to the supply of high-grade ore. Afterward they told me that they had placed the development work in charge of a bank clerk whose health would not allow him to remain longer in the bank. The bank clerk's intentions were undoubtedly good; but such failures are often most discouraging to the financial backers, and do much to hinder and postpone legitimate development. Often the owners of valuable deposits are "dogs in the manger." They do not have the capital, enterprise and experience to develop their property, and seem afraid that, if they lease it, the lessee will make a few dollars. A fair royalty on a manganese property, where the risk is small and the ore can be mined quickly and without expensive equipment, may be considered as 10% of the value of the ore on the railroad cars, and, in exceptional cases, from 5% to 10% of the profits. On propositions where returns are slower, and large sums must be spent for equipment before any returns are made, I think a smaller royalty should satisfy a reasonable man. Our country needs manganese, and if a man has ore that can be of service in winning the war, it is his particular duty to make such concessions as will secure the ore for immediate use where it is needed. The owner should remember that a small percentage of the present high price will yield him larger returns than a 50% royalty in normal times, and that present high prices will be obtainable for only a limited time.

To sum up, the principal cause of low production is that many manganese mines that are practically developed to the producing point are now lying idle. A few capitalists have recently taken hold of this industry, with favorable results, but in order to increase production it is necessary that more become interested.

MARSHALL HANEY.

Geer, Green Co., Virginia. Aug. 17, 1918.

Grinding Ore in Ball Mills

Referring to the *Journal's* comment on my article on "Grinding Ore in Ball Mills" in the Sept. 7 issue, I frankly agree that "all-sliming" is a very loose word, and should hardly ever be used, but it often is where final grinding is barely through 60 mesh. We speak of treating slimes by flotation when these slimes carry 2 or 3% plus 48 mesh, and not more than 60% minus 200 mesh.

I think your corrections altogether are not correct, as Mr. Bosqui specifically states in his papers that 39% of the total pulp is for sand treatment by cyanide leaching, and, of this, 11% is minus 200 mesh. You state "the greater portion of the final product is sand." The product made by these Rand tube mills is as fine as the material from many of the so-called all-sliming cyanide plants of this country.

It is well known that rock is used in place of pebbles in this district. Mr. Bosqui, however, uses the word pebbles.

F. E. MARCY.

Salt Lake City, Sept. 11, 1918.

[We must disclaim responsibility for the opinion with which our correspondent is in agreement. No mention was made of the looseness of the term "all-sliming" in the editorial note in question; neither did we suggest any restrictions in its use. We explained that Rand practice is not "all-sliming"; and, in reaffirming this, we would say that it is not feasible to class the average Rand tube-mill product in the same category, as regards fineness, as the material from any all-sliming plant either in this country or elsewhere. Our explanation as to the character of the grinding medium used on the Rand was not a meticulous differentiation between the words "pebble" and "rock," but was given, as we stated at the time, to emphasize the difficulty of using Mr. Bosqui's data for comparison with the results of the operation of a short mill using heavy steel balls.—EDITOR.]

Referring to Mr. Donald H. Fairchild's article in the Aug. 17 issue of the *Journal* in which he states that it took four months for the operators to learn how to operate a Marcy mill, I have before me a reprint from the April, 1918, Bulletin of the A. I. M. E. in which Mr. Kennard makes the following statement: "After the strike at the Inspiration Co.'s concentrator, new operators, not experienced with the Marcy mill, were able to obtain a tonnage of only about 750 tons per 24 hours from each section of two mills, this being the same tonnage as was obtained during the first year's operation of the Marcy mills in this plant. This indicates that it is the high-priced millman, and not the machine, that should be given credit for excess efficiency." Mr. Fairchild confirms Mr. Kennard's statement as to this condition.

The thought has been running through my mind of what would happen if millmen should leave every two or three months, or just about the critical time when they had learned to operate the cylinder mills. This may not be general as applied to the Marcy mills, and I think that if the grated cylindrical mill has any champions, they could take up the cudgels and prove that Messrs. Fairchild, Del Mar and Kennard are in error.

E. W. LAWLER.

Hardinge Conical Mill Co., New York, Aug. 31, 1918.

Although I am considerably interested in ball mills and their adaptability to the grinding of various ores, I had not intended commenting upon Mr. Del Mar's or Mr. Fairchild's letters on this subject. Mr. F. E. Marcy, in his discussion of this matter, quotes an extract from a paper by Mr. F. L. Bosqui, which is published in Vol. 52 of the Transactions of the American Institute of Mining Engineers, and not Vol. 53, as stated by Mr. Marcy. In fairness to Mr. Del Mar, I believe that if Mr. Marcy takes it upon himself to quote from Mr. Bosqui's paper, he should also quote from the other portions of the paper containing matter pertinent to this discussion.

Mr. Bosqui states that the "crushing efficiency" is the tons of minus 90-mesh material produced per mill and that the mechanical efficiency is the tons of minus 90-mesh produced per horsepower. He also states that the use of the quick-discharge device increases the wear on the crushing media by 300 to 400%, thus substantiating the statement made by Mr. Del Mar. Mr. Bosqui also states that varying this quick-discharge device from the maximum possible (a peripheral discharge) to the ordinary trunnion discharge, a steady decrease in crushing efficiency (tons of finished material produced per mill) is accompanied by a proportionate decrease in power consumption, thus maintaining the mechanical efficiency, or tons of finished material produced per horsepower, at a comparatively constant figure.

At the plant of the Smuggler Union Mining Co., at Telluride, Colo., two trunnion-discharge ball mills are used, as well as one grated ball mill. The consumption of cast-iron balls in the grated mill is approximately 2½ lb. per ton, the trunnion discharge ball mills using only 2 lb. per ton. The grated mill also handles only 3.03 tons per horsepower day from minus 4 mesh to all minus 60 mesh, the trunnion discharge ball mills handling 4.67 tons per horsepower day between the same limits.

At this plant the grate and lifters were removed from the grated mill, making it an ordinary trunnion-discharge short tube mill. As a result of this change, the ball consumption was decreased, and the capacity increased over what it had been when operating with the grate.

Referring to Mr. Marcy's third point, that the diagram given by Mr. Del Mar as illustrating the pulp line in the Marcy mill is incorrect, Mr. Marcy states that the pulp line is away from the influence of the balls, and is nearly a straight line over the entire length of the mill. This does not agree with the pulp line as indicated by Mr. Fairchild, who was formerly a salesman for Mr. Marcy, nor with the cut on page 7 of Mr. Marcy's catalog No. 42. There are apparently four different ideas of the pulp line in this mill, and Mr. Del Mar and the Marcy catalog seem fairly well in agreement as to the pulp line, both showing that there must be a considerable volume of balls above the pulp, which must naturally be worn more than would be the case if they were covered with pulp. It should be noted that Mr. Bosqui and the Smuggler Union Mining Co. both agree that the consumption of grinding media in a mill when using the quick-discharge device is greater than when this is not used. This has also been the experience of a mining company at Cobalt, Ont., where the grates were removed from the mill, and lower ball consumption and greater capacity resulted from the change.

With reference to Mr. Marcy's fourth point, that at Inspiration there is no greater wear at the discharge end than at the feed end, I beg to differ with him, since I have been advised that all the liners used in Marcy mills at Inspiration show considrably greater wear at the discharge end than at the feed end, and that the liners must be scrapped, owing to excessive wear at the discharge end, although the feed end is still in fairly good condition.

In the grated ball mill there is a segregation of the large balls at the discharge end and of the small balls at the feed end. This has been observed several times at the Vindicator Consolidated Gold Mining Co.'s mill, at Cripple Creek, as also at the Inspiration plant, in Arizona. If one of these Marcy mills at Inspiration is investigated after the mill has been removed from its bearings and taken to the repair shop for relining, this segregation will not be found, owing to the fact that the feed is shut off for several hours before the mill is stopped, in order to grind out all the ore contained in it. If one of these mills is stopped, however, at the same time the feed is shut off, such a segregation will be found.

I certainly agree with Mr. Del Mar in his opinion that it is a fallacy to use a grated mill when grinding a classified feed, or grinding a feed already fine enough to pass the grate openings, for then the ore is pumped out of the mill by the action of the lifters, before it has an opportunity to be sufficiently ground.

ALF. TELLAM.

Denver Engineering Works Co., Denver, Colo., Sept. 13, 1918.

Assayer and Chemist

Rapid Estimation of Cadmium In Spelter*

By H. Isaacs

I have done a considerable amount of work in the analysis of zinc slab and spelter, using exclusively the method approved by the American Chemical Society (*Journ. Ind. & Eng. Chem.*, Vol. 7, No. 6, pp. 547-548), and have evolved a modification of the method prescribed for the determination of cadmium, whereby from three to four hours is saved in the analysis. The principles involved are identical with the original scheme, but the details and manipulation vary somewhat.

Twenty-five grams of borings are weighed out into a 500-cc. beaker, 250 cc. water, and 59 cc. conc. HCl added. The beaker is placed upon a low hot plate, and allowed to stand overnight. In the morning, it will be found that all but a gram or two of the zinc has been dissolved, and the cadmium is untouched. Filter, transferring a piece of the undissolved zinc first to the filter paper, wash two or three times with hot water, and wash the residue into a 500-cc. casserole. Add sufficient nitric acid to dissolve, keeping covered meanwhile with a watch-glass, add 20 cc. of 1:1 sulphuric acid, and evaporate to sulphur trioxide fumes. Allow to cool, add 150 cc. hot water, and bring just to a boil. The precipitated lead sulphate may be filtered off immediately.

Collect the filtrate in a 350-cc. beaker, dilute to 200 cc., and add 5 cc. of a saturated solution of ammonium chloride. Insert in beaker a piece of glass tubing, 5 to 7 mm. in diameter and about 5 in. long. Connect this tube with the hydrogen sulphide generator, and allow a steady stream of the gas to pass through the solution for half an hour. A drop or two of ammonia may be necessary to start precipitation. The official method recommends the hydrogen sulphide for one hour, but I have found half this time with a steady stream to be ample. Remove beaker from generator, retaining tube for use as a stirring rod.

Filter rapidly through a double 12½-cm. No. 41 Whatman paper, wash two or three times with hot water, and transfer paper entire to a 150-cc. beaker. Do not scrub the sides of the beaker to remove adhering particles of sulphide. Pour 60 cc. of 1:5 sulphuric acid into beaker upon filter paper, and break up latter with a stirring-rod. Boil until all sulphide has been decomposed. Filter at once into original beaker in which precipitation was made, dilute to 200 cc., add 5 cc. ammonium chloride solution, and re-precipitate as cadmium sulphide, using original glass tubing as hydrogen sulphide conveyor. Filter, and wash slightly, as before. Transfer filter paper to original beaker in which precipitation was made, and boil up with 60 cc. of a 1:3 hydrochloric acid solution. Add a few drops of nitric acid in order to oxidize the sulphur.

When dissolved, filter into a 200-cc. electrolytic beaker, and wash three times. Add a few drops of phenolphthalein, then an excess of a saturated NaOH solution, until a deep red is obtained. Add a freshly prepared saturated solution of KCN until the precipitated cadmium hydroxide redissolves. Electrolyze, keeping solution stirred by air or mechanically. All the metallic cadmium is deposited within half an hour. Strict adherence to the directions prescribed by the official method lengthens the time for the determination by at least four hours. Weighing a sample at 5 p.m., before stopping work, and digesting it overnight, makes it possible to finish the determination before noon the following day.

*Abstracted from the "Chemist-Analyst."

Assay Practice Economies on the Rand*

By C. Toombs

In the modern up-to-date assay office there is not the same scope for economies that existed some years ago; still there are a few points which may be touched upon. The biggest item in the aggregate of stores costs is litharge. Many who believe in "parting" everything, would be glad to be provided with a cheaper brand of litharge, free from gold, but unrefined as regards silver. This might suit the manufacturers, and would be a saving to the user—cheaper litharge, and less silver to be added to a charge. I now raise this question: Is litharge being used for its proper function; namely, a lead producer for gathering the gold contents in a charge under fusion, or is it also being used as a flux? Litharge as a flux at $15 to $17.50 per 100 lb. is a luxury, when sodium carbonate at $3 per 100 lb., plus a good heat, is all that should be necessary. I have recently seen a flux for a 5 A.T. charge in which 4 A.T. litharge was used; presumably a 40-gm. button would be reduced, thus leaving 2½ A.T. litharge in the slag. Personally, I agree with the theory that "borax is an effete superstition." If the furnaces are kept in good condition, and run at a high temperature, I have found the use of borax unnecessary, and the resulting lead button comes away cleaner and brighter from the slag.

For many years I have used only cupels made in my own department. They are made with a cement bottom and cupel powder top—two-thirds cement, one-third cupel powder—a decided economy. I still use the old swinging screw type of cupel machine, and, on the whole, find it satisfactory. One boy can turn out almost 20,000 cupels per month, at an average cost of about 50c. per 100.

All silver used should be re-precipitated and recovered; by flattening and rolling into thin strips it can be used over and over again, a small additional amount

*Excerpt from "Journ. Chem. Met. & Min. Soc. of S. Africa."

monthly making up the working losses. I find that the working loss on 17,000 to 20,000 partings per month averages about 3 ounces.

In solution assaying, the old method of reduction and precipitation by means of sodium sulphite and copper sulphate, in a hydrochloric acid or sulphuric acid solution, may be safely abandoned for the more economical one of precipitation by means of prepared cuprous chloride. Commercial hydrochloric acid, commercial copper sulphate, and scrap copper wire are all that is required to make cuprous chloride solution, giving instantaneous precipitation of gold from solution in the cold.

Chemically pure nitric acid especially free from chlorine and iodine is an essential in gold assaying, but something might be done by economizing in its use. Keep the quantity used in parting as small as possible—a big excess is always used, probably a hundred times more than is theoretically necessary for the average small beads. Then in bullion parting, the strong acid from today's bullions can be diluted down for tomorrow's first weak acid, with considerable advantage.

Determination of Tungstic Acid In Wolframite*

Inconsistent and unsatisfactory results were obtained with various methods for the determination of tungsten in wolframite. The precipitation method originally described by Treadwell, embodying the precipitation of tungstic acid with nitric acid, is not quantitative for this purpose and is subject to losses of 8 to 10% or more; the filtrate from this precipitate was always found to contain an appreciable amount of tungsten. The method more recently employed by Treadwell, involving the fusion of the mineral with sodium carbonate and extraction with hot water and treatment with concentrated hydrochloric acid, failed to give any better results. The same was true of the Berzelius method, involving fusion with alkali and final precipitation with H_9NO_3.

Incomplete precipitation of tungstic acid by treatment with a mineral acid, such as nitric or hydrochloric acid, is due to silicic acid, which is always present in wolframite; this reacts with tungstic acid to form very soluble silicotungstic complexes, which are only slightly hydrolyzed by acid under the conditions of analysis and are not destroyed by repeated evaporation with nitric acid nor even by heating to 130°. The Berzelius method is also inaccurate because the mercury salt of the silicotungstic acid formed is rather soluble in warm slightly acidulated water.

The G. von Knorre method was employed in the following manner and was found to give satisfactory results: The mineral was decomposed by fusion with sodium carbonate; the aqueous solution obtained therefrom was neutralized with hydrochloric acid, using a methyl orange indicator; 10 c.c. of N/10 sulphuric acid was added and tungstic acid was precipitated at ordinary temperature by addition of excess of benzidine-hydrochloric-acid solution; silica after ignition was eliminated by evaporation with sulphuric and hydrofluoric acids. The filtrate was free from tungsten.

Satisfactory results were obtained when the method was applied to pure, crystallized sodium tungstate and tungstic acid. All of the above methods are satisfactory for analysis of compounds such as pure sodium tungstate, etc. The von Knorre method alone is recommended for determination of tungstic acid in minerals such as wolframite and scheelite, which contain silicic acid. This method has the following advantages: (1) the formation of the silicotungstic complex at ordinary temperature is practically *nil*, and consequently the amount of silica so obtained is so insignificant as to require no separation in most cases; (2) formation of the silicotungstic complex has no appreciable influence on separation of tungstic acid and precipitation of benzidinesilicotungstate is quantitative; (3) after incineration the silica present (from decomposition of the silicotungstate) may readily be eliminated, and the total content of tungstic acid may thus be obtained.

*Luis Guglialmelli and Ulaus Hordh. Anales. Soc. Quim. Argentina 5. 81-90, 1917; Chem. Abstr.

Determining Molybdenum in Steel*

The steel to be analyzed is dissolved in dilute sulphuric acid, the ferrous sulphate oxidized by the addition of powdered potassium permanganate, avoiding an excess, and the mixture is then rendered alkaline with potassium hydroxide, boiled, and filtered. An aliquot portion of the filtrate is diluted, faintly acidified with hydrochloric acid, and treated with an excess of standardized titanium trichloride solution; the excess is then titrated with ferric chloride solution, using potassium thiocyanate as indicator. In solutions containing less than 0.05 gram of molybdenum per liter and having an acidity corresponding with 1 c.c. of free HCl per 100 c.c., the reduction proceeds according to the equation $2MoO_3 = Mo_2O_5 + O$. Vanadium may be determined in a similar way, the reduction being according to the equation $V_2O_5 = V_2O_4 + O$. If molybdenum and vanadium are both present in a steel, they are determined together as described; the vanadium is then determined colorimetrically (with hydrogen peroxide), and the molybdenum is obtained by difference.

*Travers, Comptes Rend, 1917; abstr. "Journ. Soc. Chem. Ind.", Oct. 31, 1917.

To Help Detect a Titration End Point†

BY W. R. GODDARD

To those who do much titrating it may be of value to know how to eliminate the dark shadow which appears in the bottom of the beaker in which the titration is being made. Although the beaker is usually placed on white paper, milk glass, or porcelain (in order to get a white background) there is always a dark shadow formed in the bottom of the beaker owing to the light having to pass lengthwise through the glass at the bottom of the beaker. This can be completely eliminated if the beaker is set on a piece of plate glass placed an inch or more above the white background. This allows the light to be reflected up through the bottom of the beaker as easily as through the sides.

†Abstracted from the "Chemist-Analyst."

Events and Economics of the War

While the British and French are forging their grip on St. Quentin on the Hindenburg line, the Allied arms are meeting new successes on the Eastern fronts; the drive in the Balkans continues, with the Italians joining in east of Monastir; in Palestine, the Turks have been routed, the British capturing 25,000 men and 260 guns in a 60-mile advance reaching beyond Nazareth. The British have withdrawn from Baku. A protectorate has been temporarily established in Archangel by the Allies. The origin and development of the Franco-Russian alliance has been revealed in the French "Yellow Book" just published.

In the United States, condemnation by the Allied and neutral governments of the massacres carried out by the Bolsheviki has been invited by Secretary Lansing. The President has set Oct. 12 as "Liberty Day" for the Fourth Liberty Loan campaign. John W. Davis, of West Virginia, Solicitor General of the United States, has been appointed Ambassador to Great Britain, succeeding Walter H. Page, resigned.

Silver Export Rules Stricter

More stringent requirements have been demanded of silver exporters by the Federal Reserve Board to prevent the available domestic supply from being drained away. Though licenses have hitherto been necessary, purchasers of goods in the Far East have had little difficulty in securing all the silver they needed for meeting their bills. The board recently published a ruling in which it says:

In order to conserve the use of silver, export licenses for silver will be granted only for civil or military purposes of importance in connection with the prosecution of the war, and only in cases where the exporter certifies that the silver to be exported has been purchased at a price which does not directly or indirectly exceed $1.01\frac{1}{4}$ per oz. 1000 fine. This quotation applies at the point where silver is refined in the United States or at the point of importation, in the case of imported silver.

It has been apparent for some time that applications for the exportation of silver were increasing and that the amounts licensed for exportation would grow greater as the difficulty of obtaining gold or securing exchange at satisfactory rates increased.

According to the board, licenses to export approximately $155,237,725 had been issued from the time the embargo was placed, late in 1917, up to May 24, 1918. From this latter date to Aug. 23, licenses were granted for $105,290,285 of silver as coin or bullion. Further applications have also been acted upon favorably for the export of $5,328,110 of silver or currency, at shippers' option.

Oil Conservation Urged

The unmined supply of petroleum now available in the United States is only about 70 bbl. for each person, states a bulletin issued on Sept. 17 by the Smithsonian Institution, in urging the necessity for conservation in the use of oil and gasoline. The bulletin, which is based on an exhaustive survey of the oil resources of the nation, says that, under present conditions of mining, a notoriously high percentage of waste is involved, amounting, according to conservative estimates, to nearly 90% of the total resource value.

The presence in this country of extensive deposits of oil shale, it is said, removes that danger of early physical exhaustion in respect to oil, but does not necessarily insure a deferment of the period of economic exhaustion which is being rushed prematurely into the present by the current wasteful use of the limited petroleum resources.

Aid for the oil producers was sought of the Senate Finance Committee on Sept. 13 by Judge Henry Covington, formerly a member of Congress. Judge Covington asked for the insertion of a depletion clause in the Revenue Bill for oil wells such as the one already allowed for mines; also that the income of individuals derived from the sale of oil wells should be taxed 20% in the place of war or excess profits or other income taxes. He forecast a serious oil shortage in the United States unless some encouragement were given to new development enterprises. There are no war profits in the oil business, according to a representative of interests in the mid-continent field, who also appeared before the committee.

Civilians May Enter Officer Schools

Applications of civilians for admission to central officers' training schools may now be received, the War Department announced on Sept. 19. The age limits for admission of civilian applicants are from over 18 to less than 46 at the date of registration. Special induction for training at these schools will be regulated so that a fair proportion of candidates shall come from (1) the Army at large, in accordance with existing instructions; (2) civilians in Class 1-A; (3) civilians of the deferred classifications, on grounds other than industry, occupation or employment, including agriculture. The announcement further reads:

Civilians in Class 1-A, who may be admitted to central officers' training schools, with a view to obtaining commissions at the close of the prescribed course, will, upon entrance to the schools, be inducted into the service for the duration of the war, and should they fail to obtain such commissions they will be required to remain in the service.

Civilians in the deferred classifications on grounds other than industry, occupation or employment, including agriculture, who may be admitted to central officers' training schools, with a view of obtaining commissions at the close of the prescribed course, will, upon entrance to the schools, be inducted into the service for the duration of the war, and should they fail to obtain such commissions, they may be given the option of a discharge from the service and a reversion to their original classifications under the selective service regulations.

The applications of civilians will be submitted, as heretofore, to the Army officers on duty at the various educational institutions throughout the country, as prescribed in the memorandum of information issued by the War Department. No applications will be considered by the War Department.

Drive To Secure Mine Labor

Through its mining division, the U. S. Employment Service of the Department of Labor has opened a drive to secure adequate working forces for the coal and war-metal mines of the country. The campaign will be handled by James Lord, chief of the mining division of the Employment Service, who also is president of the mining department of the American Federation of Labor; E. B. Chase, general manager of the Berwind-White Coal Mining Co., of Philadelphia, representing the mine operators, and William Diamond, former statistician of the United Mine Workers.

As the opening step, a circular letter, signed by Director General Densmore, is being sent out to the secretaries of 3500 locals of the United Mine Workers in all parts of the United States. Through the use of their transfer card records these secretaries are expected to report to the mining division of the Employment Service the names, addresses, and present whereabouts of all practical mine workers who to their knowledge have in the last few years left the mines for other work. As soon as the reports of transfers have been received, the Employment Service will get in touch with all those who have left the industry for less important occupations, and by means of personal solicitation urge their return to the mines.

Fourth Loan Campaign Opens

The Fourth Liberty Loan, the selling campaign for which opens today, Sept. 28, is expected to dispose of about $6,000,000,000 in bonds. These will be 20-year 4¼% bonds dated Oct. 24, 1918. The first coupon will be payable Apr. 15, 1919, and will be for 173 days' interest. The bonds will be issued in the following denominations: $50, $100, $500, $1000, $5000 and $10,000; $50,000 registered, $100,000 registered.

Payment must be made at the rate of 10% of the subscription with the application; 20% on Nov. 21; 20% on Dec. 19; 20% on Jan. 16, 1919; and 30% and interest on Jan. 30. The campaign will close on Oct. 19.

The Administration bill designed to stimulate the sale of Liberty Bonds by exempting from income tax and surtaxes the interest on the Fourth Liberty Loan up to $30,000, and up to $45,000 on earlier issues, was sent to the President on Sept. 23.

Tin and Platinum Drive Pending

The American Red Cross is putting its machinery into operation in all parts of the United States for salvaging platinum and tin. The drive for platinum is for the purpose of building up a reserve stock needed for making contact points for magnetos to be used in tractors, trucks, automobiles, motorcycles, and gas engines; contact points for telegraph and telephone systems, and chemical apparatus and scientific instruments.

The forms in which tin will be collected are limited to three, namely, foil of every kind, collapsible tubes, and pewter articles, in which a very large percentage of tin is found. Tin cans are not worth collecting.

The drive will be under the general direction of the Red Cross Bureau of Conservation at national headquarters in Washington, operating through similar bureaus at divisional headquarters.

New Passport Rules in Effect

New rulings on passports became effective on Sept. 15, to the end of insuring greater public safety by establishing more accurately the status of passengers traveling between this country and foreign ports. Engineers and other citizens desiring to leave or enter the United States will find greater difficulty in securing passports than heretofore. Passports will not be issued unless the applicant can make it affirmatively appear that there are adequate reasons for his departure or entry and that such departure or entry is not prejudicial to the interests of the United States.

Export Conservation List Increased

The War Trade Board has announced in a new ruling (W.T.B.R. 216) the addition of the following commodities to the Export Conservation List, which became effective on Sept. 11, 1918: Aluminum, metallic and all articles containing 10% or more in weight of metallic aluminum (individual licenses not required in Canada or Newfoundland); cartridge shells loaded and unloaded; pig lead, lead pipe, sheet lead; oxide of tin, bichloride of tin, tin salts, tin crystals, sundry articles either made of tin plate or coated and dipped in tin; titanium alloys, titanium compounds, titanium ores, uranium alloys, uranium ores and uranium salts; also luminous compounds, ores and salts of radium.

British Army Returns Miners

"The government is making every effort," says a mining correspondent of the London *Times*, "to expedite the release of miners of low medical categories. During the last three months such men have been sent back from the army at the rate of nearly 100 a day, but the need for more coal is so great and urgent that extraordinary measures are now being taken to get men quickly from France into the mines in order to increase the output of coal. Soldiers who are eligible for release should take steps at once to be sent home. Any man (excluding members of the administrative, managerial, and clerical staffs) who was employed above ground or below ground at coal mines before the war, and continuously up to the date of his enlistment, and is in medical category B2 or B3, and serving at home, is eligible for release, provided he can be spared from the unit in which he is serving. Particulars of the scheme have been circulated by the military authorities in regimental orders."

The training camp for the Chemical Warfare Section, now under construction at Lakehurst, N. J., will be named Camp Kendrick, in honor of Professor Henry L. Kendrick, a retired Army colonel who served as professor of chemistry, mineralogy, and geology at the Military Academy.

Prohibition of the sale of intoxicating liquor within five miles of coal mines for 60 days after Oct. 1 is proposed in a bill introduced on Sept. 18 by Senator Myers, of Montana. It was referred to the Judiciary Committee. Senator Myers said such a step would aid greatly in overcoming the threatened coal shortage this winter

Industrial News from Washington

By Paul Wooton, Special Correspondent

The War-Minerals Bill

An agreement on the War-Minerals Bill has been reached by the conferees for the Senate and the House. Two new sections were added to the bill, and the Shafroth amendment, providing administrative headquarters be situated west of the Missouri River, was stricken out. Several other minor changes were made in the bill as it passed the Senate.

In Section 2 of the bill, the portion referring to sales was changed so that such sales "shall not be at a price less than the purchase or cost of production thereof." One of the new sections provides that "no person having a pecuniary interest in any transaction in pursuance of this act shall have any official connection under this act with such transaction." Penalties are provided for the violation of the act. The termination of the act upon the proclamation of peace is additionally safeguarded. In the other section, provision is also made that no person is to be exempt from military service because of employment in the administration of the act.

The President has written Senator Henderson congratulating him on the unanimous adoption of his bill by the Senate. "You have rendered the country a generous service," wrote the President, "in your management of this piece of legislation. I am sure it will be fruitful of the most useful results."

Revenue Bill To Cover New Orebodies

The Senate Finance Committee has been asked by James F. Callbreath, the secretary of the American Mining Congress, to add a paragraph to the revenue bill to provide for new orebodies. The paragraph proposed is as follows:

> Provided that in the case of mines, oil and gas wells there shall be included in surplus a reasonable amount to represent the value of after developed orebodies or deposits; said amount to be determined under rules and regulations to be prescribed by the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury.

Another proviso was suggested as follows:

> Provided that in the case of mines, oil and gas wells, the excess-profit credit shall consist of a specific exemption of $3000, plus an amount not less than 10 nor more than 25% of invested capital, such percentage credit to be determined by the Commissioner of Internal Revenue under such rules and regulations as he may prescribe.

Lead Output Meeting Demand

Reports to the War Industries Board indicate that lead producers are holding their own against consumption. The discontinuance of exports of pig lead to foreign commercial buyers is helping matters.

Some consumers are not getting as much lead as they want, but all appear to be making the best of things, judging from their communications to Washington. The clearing of all lead through the committee is believed here to be having an important bearing on making consumers more careful. Great savings are being made by curtailing unimportant uses of the metal. Bird shot, for instance, was used at the rate of 20,000 tons annually during the first six months of 1918. This is a reduction from 24,000 tons used in 1917 and 28,000 tons in 1916. The rate of use of bird shot will be further reduced during the latter half of the current year, it is believed.

Pope Yeatman and his staff, who are in charge of non-ferrous minerals for the War Industries Board, are paying particular attention at this time to the paint problem.

Pig Tin Licensed

Extension of the licensing system to pig tin was announced by Bernard M. Baruch, chairman of the War Industries Board, on Sept. 20. The official announcement reads in part as follows:

> All users and dealers in pig tin will be licensed, and a complete inventory of stocks on hand and contracts unfilled will be made, and, if necessary, supplies will be redistributed to equalize same according to essential uses. Full details of licensing plan will be announced later.
>
> In accordance with this decision of the War Industries Board, questionnaires are being sent out to the 2000-odd individuals and plants affected, calling for the information, under oath, demanded by the inventory. On the facts to be thus gathered as to the actual supply of pig-tin stocks and the unfilled contracts, and the manner and quantities in which the pig tin is being held, the War Industries Board will decide whether essential uses demand an equalization of such stocks through redistribution and a matching-up among the plants.
>
> The tin section of the board has been informed there is considerable uneasiness in the trade as to control by the War Industries Board of the pig-tin situation, and it is the belief of Mr. Cranwell that announcement of positive plans of control will prove beneficial. He says that the control plan will affect only the users and dealers in pig tin, and that the public, which uses tin plate, will be benefited by the licensing system of control.

The announcement then sketches the method by which the world's supply of pig tin will be distributed under the newly formed inter-Allied pool, which has already been described in detail on page 541 of the last issue of the *Journal*. T. G. Cranwell is acting chief of the tin section of the War Industries Board.

Zinc Men Seek Protection

Protection of American zinc producers from foreign competition was asked last week of Bernard M. Baruch, chairman of the War Industries Board, by Missouri's delegation in Congress, which was headed by Senator Reed and Speaker Clark. They stated that the present rate of importation from Mexico is keeping the price of zinc at a point where a large number of American properties cannot operate.

A decree published at Mexico City exempted from import duty all mining and industrial machinery from Sept. 1, 1918. Before that date the duty was 45c. per 100 pounds.

Mexican Mine and Metal Taxes Fixed

A presidential decree, effective Apr. 26, has imposed an internal stamp tax on gold, silver, and industrial metals in Mexico, according to the *Bulletin of the Pan-American Union*. The decree reads as follows:

A. Eight per cent. on the value of gold and silver exported in the form of ore, concentrates, cyanide or sulphides or smelting residuums, or in any other form combined or mixed with substances not properly known as metals.

B. Seven per cent. on the value of gold and silver exported after the same has been treated in the country up to the grade of being combined or alloyed only with metals, no matter what may be the proportion of the mixture.

C. Six per cent. on the value of copper exported in the form of ore or concentrates of less than 50% copper. When the New York price of electrolytic copper is less than 20c. U. S. currency per lb., this tax will be 5 per cent.

D. Five per cent. on the value of copper in bars, mattes, or concentrates of more than 50% copper content, and 300gm. of silver and 5gm. of gold per ton, the New York price of copper being 20c. per lb. or over. The silver and gold pay under paragraphs A and B, except as hereafter set out.

E. In the case above, when the New York value of copper is less than 20c. U. S. currency per lb., the import on the copper content is reduced to 4 per cent.

F. Two and a half per cent. of the value of copper in bars, mattes and concentrates having a copper content of more than 50% and less than 300gm. of silver and 5gm. of gold per ton, without regard to the New York market price of copper.

G. Three per cent. of the value of lead, tungsten, molybdenum, manganese, graphite, and mercury.

H. One per cent. of the value of zinc, tin, antimony, and other metals or minerals and substances containing the same not classified in the paragraphs above.

I. Seven per cent. of the value of gold and silver presented at the mint for coinage.

The mint will receive for coinage, gold and silver from private individuals, without limit as to gold, and as to silver on special order from the Treasury Department. Pure gold is to be taken at the rate of 1,333.33 pesos (Mexican gold) per kilogram and pure silver at the New York price in Mexican money as of the day of presentation at the mint.

The import is not to be collected on:

A. Old national or foreign gold coins presented at the mint for recoinage.

B. Gold and silver exported in the form of ore, earth or powder, in the natural state or mechanically concentrated, and in cyanides, sulphides, or smelting residua, provided that the amount of gold does not exceed 2gm. per ton and the amount of silver 250gm. per ton.

C. Copper ore of less than 3% copper content; lead ore of less than 8% and zinc ore of less than 15% zinc content.

D. Gold and silver produced by smelting foreign ores. Four months' period for smelting allowed.

E. Gold and silver employed in national industries.

F. Mineral specimens in the natural state up to 10kg. in weight and 10 pesos in value.

Included in the same decree, the annual mine property tax is fixed on a progressive scale as follows:

From 1 to 5 pertenencias (claims), at the rate of 6 pesos yearly per pertenencia, or 2 pesos per tercio (third).

From 6 to 50 pertenencias, at the rate of 9 pesos yearly per pertenencia, or 3 pesos per tercio.

From 51 to 100 pertenencias, at the rate of 12 pesos yearly per pertenencia, or 4 pesos per tercio.

Above 100 pertenencias, at the rate of 18 pesos yearly per pertenencia, or 6 pesos per tercio.

The progressive feature is to be applied in all cases where pertenencias belong to the same owner and are registered in the same mineral district.

South African Mining Prospects

In a presidential address before the Science Association, Dr. Percy A. Wagner stated that the Union of South Africa is not only the world's leader in the production of gold, diamonds, and corundum, but possesses the greatest known reserves of these minerals. The recorded gold production to date amounts to 4609 tons, valued at £571,400,000; and on the basis of pre-war costs he estimates the gold still capable of being profitably recovered on the Witwatersrand to be worth £1,200,000,000. There can be no question that 50 years hence gold-mining operations on a large scale will still be conducted on the Far East Rand, and possibly also in some sections of the Witwatersrand. Dr. Wagner urged the establishment at Johannesburg of a mint. He stated that the diamond production to date has amounted to 31 short tons, of a declared value of £216,-165,764, which was probably not much more than one-half of what the diamonds finally realized in a cut state. At the present time, owing to the policy adopted by the leading producers of carefully adjusting the output to the amount of money the world was prepared or inclined to spend on the purchase of diamonds, the industry is in a sounder position than it has ever been before.

The coal industry is making steady progress, and is capable of considerable expansion. An export trade to South America seems to offer great possibilities, and it is to be hoped that after the war a direct service of steamships will be established between the Cape and Buenos Aires. In regard to South African coal reserves, it has been generally conceded that the estimate made in 1911 which placed these at 56,000,000,000 tons erred considerably on the conservative side. The prospects of the coal byproduct industry are excellent.

As a result of conditions created by the war, South Africa is at last about to enter the ranks of the world's iron producers, Dr. Wagner said. Four small blast furnaces are either actually completed or nearing completion, and the prospects of the iron industry are hopeful. The dimensions which the industry may ultimately attain depended upon the success of the efforts to be made at Pretoria, as soon as practicable, to smelt the rich titaniferous ores of the Bushveld complex in admixture with the siliceous ores of the Pretoria series. Dr. Wagner estimated that there were over 3,000,000,000 tons of these ores available; and if they could be smelted on a large scale, using cheap Transvaal coal as fuel, South Africa would be able to export iron and steel in competition with the leading iron-producing countries.

The copper industry received a severe set-back by the decision of the Ministry of Shipping to stop the shipment of copper concentrate and matte. In any case the outlook of the copper industry is none too bright, owing to the serious fall in grade that has taken place of recent years in the mines of Little Namaqualand and at the Messina mine. The future of the Namaqualand copper district depends on the introduction of economical methods, such as leaching or flotation for the beneficiation of the enormous reserves of low-grade ore in the existing mines. The tin-mining industry, on the other hand, is in a flourishing condition owing to the high price of the metal; and asbestos and corundum are being produced in ever-increasing quantities.

Henry R. Merton Co., Ltd., of London, have begun an action for libel and slander against W. M. Hughes, the Prime Minister of Australia. However, Mr. Hughes continues to attack that company in the series of political speeches that he is now delivering throughout Great Britain.

Here's to the Twenty-Seventh

Here's to our gallant regiment, whose spirit knows not fears—
The glorious Twenty-seventh of mining engineers.
They set the guns that kill the Huns. Then here's three rousing cheers!
They'll surely win, they'll reach Berlin, our mining engineers.

So say we all of us, as the Institute members sang above at their banquet in Colorado Springs before their recent meeting ended. Mrs. George M. Taylor, of Colorado Springs, wrote the words, and the members furnished the harmony. They had previously "passed the hat" for the Comfort Fund, as has been told before, so they had a right to sing in this strain.

Many who have been interested in the way the mining regiment was raised and have admired the men who had nerve enough to enlist in it, have no doubt had the desire at times to express their kind regard for the men without knowing how to go about it. To such the Comfort Fund will be a welcome means for demonstrating their feelings in a way that counts and that is unmistakably sincere. The Fund proves how the givers stand.

HOW THE COMFORT FUND STANDS

Previously acknowledged	$14,436.50
H. Foster Bain	10.00
Marc Bailey	10.00
Charles Le Vasseur (second contribution)	10.00
William Wraith	25.00
H. A. Wheeler	10.00
Nevada Mine Operators' Association	100.00
Louis R. Wallace	50.00
H. P. Bowen	5.00
H. L. Brown and M. W. Hayward	16.00
Iron Cap Copper Co.	50.00
W. N. Smith	10.00
E. S. Geary	5.00
H. J. Wolf	10.00
F. H. Siebold	10.00
H. A. Kee	10.00
W. S. Grether	5.00
Marion J. Thomas	10.00
E. F. Eurich	10.00
Liberty Bell Gold Mining Co.	200.00
H. De Witt Smith	15.00
Associated Miners of the University of Idaho	10.00
New Idria Quicksilver Mining Co.	100.00
F. P. Burrall	25.00
Livingston Wernecke	5.00
E. P. Mathewson	50.00
Interest to June 26	82.61
H. W. Hixon	10.00
R. C. Canby	10.00
S. R. Guggenheim	10.00
Richard Tavis	5.00
Simon Guggenheim	100.00
J. V. Kelley	10.00
Algernon Del Mar	4.00
Sumner S. Smith	5.00
Will H. Coghill	10.00
Lincoln Crocker	10.00
C. E. Dewey	10.00
Plymouth Consolidated Gold Mines, Ltd.	100.00
United Eastern Mining Co.	50.00
W. A. Wilson	20.00
Oscar Lachmund (fifth contribution)	10.00
W. Rowland Cox	10.00
L. D. Huntoon	5.00
Alaska Mining and Engineering Society	50.00
W. R. Benedict	3.00
Etheredge Walker	25.00
Fritz Mella	25.00
Richard McCarthy	100.00
J. N. Houser	10.00
Weedon Mining Co.	50.00
William H. Kinnon	30.00
A. P. O'Brien	10.00
Lester W. Strauss	10.00
Montana Society of Engineers	50.00
W. R. Atkeson	2.50
Charles Le Vasseur (third contribution)	5.00
Frank Carroll	10.00
V. P. Hastings, Jr.	5.00
D. E. Woodbridge	5.00
Harvey B. Small	10.00
J. C. Porter	10.00
A. F. Taggart	10.00
G. E. Farish	25.00
H. K. Sherry	10.00
T. M. Hamilton	50.00
George O. Argall	10.00
C. T. R.	15.00
Oscar Lachmund (sixth contribution)	10.00
P. M. Arnold	10.00
W. A. Wolf	5.00
Employees of Utah Leasing Co., Newhouse, Utah	20.50
Employees of Braden Copper Co.	112.50
Charles A. Mitke (second contribution)	10.00
G. M. Colvocoresses	25.00
Charles Le Vasseur (monthly)	5.00
A. H. Wethey	25.00
S. Ford Eaton	25.00
H. H. Hunner	5.00
N. G. Thomson	25.00
Members of the A.I.M.E. meeting in Colorado Springs, Sept. 4, 1918	215.00
Glen Miles	25.00
J. B. Wilmarth	25.00
Frederick MacCoy	5.00
Balance of a certain Joplin contribution received through Lieut.-Col. Gilmore	590.36
H. V. Croll	5.00
American Zinc Institute	1000.00
Thomas H. Leggett	15.00
W. F. Pyne	10.00
Earl B. Crane	5.00
Total	$18,347.97

Make your checks payable to W. R. Ingalls, treasurer of the Association of the 27th Engineers.

Payrolls vs. Fourth Liberty Loan

The following letter, written on Sept. 5 by Lewis B. Franklin, director of the War Loan organization at Washington, to Benjamin Strong, Governor of the Federal Reserve Bank, New York, emphasizes the need of increasing the number of individual subscribers to the Fourth Liberty Loan bonds, as well as the necessity of boosting the amounts of individual subscriptions. Such action must characterize the work of the various committees to insure a successful floating of the issue, and that Americans, particularly American labor, will whole-heartedly meet this opportunity of expressing patriotism there is no doubt:

In the Third Liberty Loan campaign, the subscription in amounts of $50 to $10,000 each brought in a total of $2,765,489,400, out of a grand total of $4,176,516,850. In view of the increased rates of taxation, both on corporate and individual incomes, provided for in the bill now under consideration by Congress, it is probable that in the Fourth Liberty Loan campaign we must largely increase the volume of subscriptions in these smaller amounts.

I know that committees throughout the country will use every effort to increase the number of subscribers, but I want to take this opportunity of emphasizing the necessity of increasing not only the number of subscribers, but the size of individual subscriptions, in order to make up the increased amount which it is necessary to raise.

Wages throughout the country are higher than ever before, and the cost of living has in few cases kept full pace with this increase. I am convinced that the wage-earners of this country have at this time a capacity for war savings and investment which until now has been only partially demonstrated.

In factories and other establishments having large numbers of employees emphasis has heretofore been placed chiefly on the number of subscribers, and this has enabled the more highly paid employees to subscribe to a $50 bond with as much credit as a similar purchase on the part of those receiving less liberal wages.

In planning campaigns in establishments where the rates of pay are high, careful analysis should be made not only of the number of employees, but of the aggregate amount of payroll. It is suggested that in addition to the honor roll competition, indicating the percentage of employees subscribing, local committees might institute a competition showing the percentage of payroll which has been subscribed to the Fourth Loan. Such a competition would put the employees of a steel mill, receiving high wages, on the same basis as those employed in a department store receiving wages only slightly higher than in the pre-war period.

A very large percentage of the cost of this war is going to labor, and labor will respond to the demands of the Government if approached in an intelligent way. I am sure that with proper effort, local committees can readily increase the per-capita subscriptions of the wage earners of their districts.

A New Cutlery Metal has been developed from combining iron, chromium and cobalt, according to *Iron Trade Review*, the announcement having been made by Prof. W. L. Goodwin, of Queen's University.

Editorials

The Gold Question

WE TAKE the following from a financial paper, which commonly expresses sound opinions:

Suggested "readjustment of the gold standard," by what amounts to a subsidy for gold mining, while it would benefit the gold miner and stimulate production, would not help the present world-wide problem of high prices. It would only aggravate the difficulty. By paying the producer 20% more for his gold at mouth of the mine, purchasing power of gold is automatically lowered so much all along the line. In a short while the mine owner would inevitably again be importuned by his laborers and workers to increase their wages, and he would also be confronted by a further increase in the cost of his materials.

Moreover, it would be nothing short of an economic crime to alter the standard of value at this time. It would amount to a breach of faith, since it would be aiding the debtor at the expense of the creditor.

Unfortunate as is the lot of the gold miner, it is a question of who is to suffer in the present predicament. His difficulty would only be alleviated for a time, while a subsidy extended to him through an arbitrary increase in the price paid for his gold would be a constant source of suffering and confusion to the whole community.

But this fallacious step would not end here. To raise the normal value of gold and, therefore, lower its purchasing power at this time, is on a par with all "easy-money" schemes, even bimetalism, advanced to meet the existing pinch in living caused by war. If it were ever a mistake to alter the gold standard it would be more than ever so now. As gold is the basis of all commercial effort in the world, so in its very scarcity today lies solution of the world-wide problem of prices. To change the standard now looks like the easiest way out of the difficulty. But it is not the best. It is only putting off the day of readjustment.

To fortify and buttress the huge volume of paper money put out during the war there will be an intense demand for gold on the part of those nations that have been using their credit to the utmost. Nations which have been injecting into their currency paper valued according to the government fiat, and central banks of issue expanding their circulation into billions, will seek in every corner of the globe to gather in the precious metal.

With the great gold scarcity that must exist after the war, added to the inevitable competition between nations to rehabilitate the world's trade and commerce, prices must fall and credit become cheap. When inflation (which is now acting like an over-supply of gold to force up prices) is checked, and gives way to a gold famine, and intensified commercial and industrial production is turned into regular business channels, the dollar will be able to purchase more, and the wage earner, investor and those with fixed incomes will come into their own.

Thus, the influences that are now at work to put difficulties in the way of gold production are the natural result of economic laws, working to corrective ends. The falling off and comparative scarcity of gold is the natural check to high prices. Scarcity of gold brought about a price readjustment after the Napoleonic wars and early struggle of the past century. Stimulated production of gold after the Boer War, on the other hand, was followed by steadily rising prices. In its relation to the great volume of new credit, gold is as scarce today as it was a hundred years ago. Its bearing upon prices will be the same now as it was then. To take, therefore, from gold any measure of its inherent corrective quality just now, by stimulating its production through artificial means, would be only delaying return to normal conditions.

The above excerpts reflect the conventional economic and banking opinion. We say "conventional" advisedly, for there is dissent, both among economists and bankers, respecting some important particulars. This dissent does not refer to such a simple thing as the fallacy of proposals to change the gold standard by saying that an ounce of gold heretofore worth $20.67 shall henceforth be worth twice as much. The dissent applies to more fundamental things, such as inflation of currency, the nature of money and the quantity theory of money. Consideration of the present gold question necessarily reverts to these fundamentals.

According to what is commonly known as the quantity theory, money is gold, or currency based on gold, and the more money there is the cheaper it is, that is, the less of commodities will it buy, and consequently the prices of commodities rise. Ever since the discovery of gold in California it has been argued by some economists, Chevalier being among the first, that increasing supply of gold would necessarily be followed by rising prices. This view was not accepted by many economists of the classical school, including Mulhall, Schoenhof, Cliffe Leslie, Tooke and Newmarch, Jevons, and others, and much less was heard of the theory when for a long series of years facts went against it. Soon after 1898, however, there was a recrudescence of the theory, especially through the expositions of Irving Fisher and other economists of Yale University, who attributed the rising prices of 1898-1907 to increased gold production and made freakish proposals for the regulation of the standard of value.

Since 1914 we have had the most stupendous rise in prices recorded in history, and the rate of gold production has been substantially stationary, or even recessional. However, there has been a greatly expanded issue of currency. The quantity of money has been greatly increased, but the gold basis is proportionately smaller than it used to be. This is what is called inflation, and to it is attributed the rise in commodity prices. Thus we revert to the quantity theory of money, in its narrow, commonly used sense, and money in this sense means gold. Among American economists the quantity theory is held firmly by the majority, without any doubt, and perhaps the same may be said of the British. But among the dissenters are such distinguished names as those of Laughlin, of Chicago, and Hobson, of Great Britain, the latter being one of the most brilliant of modern economists.

Now, according to the quantity theory and its exponents, the present plight of the gold mines of the world is just what ought to be. It has been taught consistently that increased production of gold would elevate prices to such a degree that the production of gold would be checked. So far events have been true to the theoretical form. But whether this will be the natural corrective and whether diminished gold production will be followed automatically by a fall in commodity prices remains to be seen.

Opposed to these theoretical considerations are some sober facts and opinions. Instead of there being too much gold, instead of our having inflated ourselves by absorbing a large part of the gold supply of Europe, the Treasury Department and our bankers are firmly of the opinion that we have none too much. Gold has been withdrawn from circulation, none is permitted to

leave the country (even at the penalty of letting the American dollar depreciate in South America and elsewhere), the Government has bought silver at an inflated price in order to use it in settling adverse balances with Oriental countries that were willing to take silver, and, finally, the industrial use of gold has practically been forbidden. All of this sounds very much as if gold were earnestly desired, and as if our financiers did not care very much about seeing the curtailment of gold production as a natural corrective, as called for by the quantity theory.

Nor is the idea of giving to American mines a bonus for the production of new gold either so ridiculous or so dangerous as some affect to view it. Such could be done without disturbing the gold standard at all. It need not be a bonus per ounce of gold. It might be an outright subsidy to producers on the basis of number of men employed, number of tons of ore hoisted, or anything else that would be reasonable. It would be expensive. Very true. But it would be no more expensive and would absorb no more man-power than to pay the bills for a depreciated dollar in neutral countries or to buy silver at $1 per ounce in order to settle Oriental balances. The maintenance of gold production by subsidy would certainly make us no richer, but neither would it make us any poorer, and it would have the advantage of preventing the disorganization of gold mining and the danger of allowing the gold mines to fall into a state in which they could not produce much at a time when gold might be more badly wanted than it is now

This raises the question For what is gold needed? and carries us back to the quantity theory of money. Hobson, in his "Gold, Prices and Wages," published in 1913, a date when no one dreamed of such events as the world has since witnessed, but which is yet recent enough to exhibit modern ideas, offers the latest and the most brilliant challenge to the quantity theory. "Suppose" says Hobson "that the gross income of this country (Great Britain) were one-tenth of the gross income of the whole world; this would give £100,000,000,000 as the quantity of money operative for a year. To this sum there has been added from an extraneous source the gross income from the gold mines, an amount of £67,000,000. The gross income from gold mining will have precisely the same amount of influence on general prices as the gross income got from the textile or metal industries. The effect would be an increase of the aggregate quantity of money to the extent of $\frac{67}{100,000}$. The influence upon prices would thus be considerably less than 0.1%. The actual influence of this addition to money in raising prices would, of course, be much less, if allowance were made for the increase of goods which has been going on. Assuming, then, that the entire output of gold was directly expended by those who get it from the mines in purchasing goods, the effect in raising world prices would be very trifling."

In his concluding chapter, Hobson discusses the paradox that has always been very troublesome to the quantity theory, namely, why is it that often when the quantity of money is greatest discount rates are highest. During this war we have had the most striking record of this sort. With huge expansion of money, with inflated currency, why should interest charges be so high? Let us quote Hobson again:

> Gold is not a base upon which is reared a block of credit that enlarges and shrinks with the length of the base line. It is not a weight to which the weights of other monetary instruments must adjust themselves. It is not even an anchor securing the vessel of finance in times of storm. The real basis of credit is goods, and the increase in actual credit is attributable to the increase of this goods basis and the concomitant increase in the demand for credit arising from the expansion of new large profitable business enterprises. . . .
>
> What plausibility attaches to the quantity theory interpreted as a gold control rests upon a hidden acceptance of the assumption that every piece of money with which payment is made must either contain, or be able to procure, a quantity of gold of the same value as the goods which it helps to exchange. But this assumption rests upon a totally erroneous assumption as to what people want money for. If every one who receives a sovereign for a sack of wheat or a pair of shoes were going to consume that sovereign, as the other will consume the wheat or shoes, the assumption that the monetary form must be equal in value to the wheat or shoes would hold. But the recipient of the sovereign paid for wheat has no intention of consuming it—what he wants it for is to use it to get hold of something which he does want to consume. . . .
>
> Since this single act of service is all they want to get from it, they must not rightly be regarded as the owners of the sovereign, in the sense in which they own either their consumable goods or their capital instruments, but as the hirers of the pieces of money which thus pass into and through their hands. Accept this standpoint and it becomes apparent that the real price of money which concerns us is not the market price of goods, but the hire-price paid to owners of money for the use of money. . . .
>
> Goods, not gold, are the basis of the modern money system. Once grasp this principle, and it becomes intelligible why gold itself when used as money is sinking from its old character of intrinsic value and becoming a form of token money.

Similar ideas were expressed by the chairman of the Ionian Bank at its last annual meeting, who argued the needlessness of gold, the Grecian finances being successfully conducted on the basis of goods. Indeed, goods and the credits for them underlie our own modern banking system, which has successfully permitted a great diminution in the gold reserve. Gold and gold certificates are rarities in this country nowadays. Yet, although the experiences during the war have pointed more and more to the ability of countries to carry on their internal affairs without gold, they have shown with equal emphasis the necessity for gold in international business. Indeed, the settling of international balances is the chief modern function of gold.

This article is not intended to be an argument in favor of a bonus on gold production, which may or may not be advisable, and pending careful consideration of many things, judgment should be reserved. But it is intended to show that certain doctrines that are held to be adverse to giving consideration to that proposal are not doctrines that are accepted by all economists; and the merit of some of them is not only doubtful but is denied. There is a form of the quantity theory of money that is clearly correct, though it is not the form that the emotional economists mean. Token money may be so debased as to put prices to an extravagant figure, as may be seen from what has happened in Russia. It is even conceivable that gold might become debased, but not by any ordinary production, as Hobson has clearly showed.

The Administration has assiduously catered to the labor unions. Now the labor unions want beer and want the President to veto the bone-dry legislation that Congress has about enacted. This is an awkward demand.

Is the Clock About To Strike 12 for Labor?

DISAPPOINTMENT was expressed last week by Emergency Fleet Corporation officials over the failure of some of the riveting gangs at the Hog Island shipyard to speed up and give the Government their best efforts.

"They are doing only 50% of what they can do at Hog Island," said Charles E. Piez, vice president and general manager of the corporation. Mr. Piez said some drastic action would be taken if an improvement is not shown.

It was remarked that on one day recently the men drove 195,242 rivets under a spur of wagers made by certain officials of the yard to see what they could do, and that on a later day only 89,407 rivets were driven.

Francis T. Bowles, assistant general manager, also expressed dissatisfaction with the work of some of the gangs.

"A situation in which a man can earn in two or three days more than enough for his weekly needs," said Mr. Bowles, "is not conducive to a steady and earnest application to his work."

It has been declared officially since then that the ship production of Hog Island will be much less than was expected this year, and will, in fact, be a great disappointment, owing to the failure of labor to work as it should.

It is alleged, moreover, that it and other shipyards have been shelters for evaders of the draft, who have obtained places on the rolls without ever intending to work.

These revelations have burst upon official Washington like a bombshell, and the press dispatches report great indignation there. The departments talk vigorously, and in Congress there are echoes, of driving out the slackers and the shirkers, giving them the choice of working, really working, six days a week, or fighting. It is declared, moreover, that no man dismissed from a shipyard will be able to get employment in another one unless he can show a proper clearance paper from the first. When official Washington talks this way we cannot help feeling that it is upholding the principle of the Butte "rustling card."

But this revelation of the real labor situation to Washington is only what every industrialist has known to be going on not only in the shipyards, but almost everywhere. In mining and manufacturing generally there has been notoriously diminished efficiency in work per hour, fewer hours worked per week, and squandering of the extravagant earnings in the short time of work. The plea for increased wages to compensate for increased cost of living has been the purest buncombe, as economists have repeatedly shown.

This behavior of labor has been, and is, a crime against the country. With the young men patriotically offering their lives, with the earnest citizens at home working as never before and cheerfully paying stupendous taxes, with the splendid women of the country going to work in the factories and the fields, there are scurvy fellows who are working only 30, 20, or even only 10 hours per week, and not working very hard at that. Many of these men, moreover, are squandering their ill-gotten gains on extravagances that absorb the work of many other men. The Government has taken steps to curtail the production of automobiles, pianos, and some few things, so that the unpatriotic cannot get them, but the Government cannot begin to view the whole list of things on which money may be squandered.

Washington itself has blindly catered to this situation by weakly conceding every demand of the most impudent of labor leaders. Claude Kitchin's stupidity, or malevolence, or both, have promoted it by his unequal scheme of taxation. We have been pursuing a political and economic policy that has been courting disaster. Why has there been such depression in our financial markets? Why have commodity prices been so fearfully high? Why has money been so desperately scarce? Whither has gone too much of the gigantic sums that have been raised by bond sales and by taxation? Answer the last question, and we answer the others. Too much of the money has gone into the deliberate waste by labor. At a time when our working force is diminished by the men in the army, the men remaining in production who ought to have worked harder than ever have practically diminished themselves by working less than full time, by not working at full efficiency per hour, and by absorbing the work of other men to furnish them with luxuries. Innocently and ignorantly—we do not say intentionally—they have been acting in behalf of the Huns, and not as patriotic Americans. We are glad that Washington at last seems to be awakening to this and intends to declare the principle of "work or fight." Let those who do not want to work take up a rifle and release a fighter who will work. And from now on, let every worker go into debt to take Liberty bonds and thenceforth work hard to pay for them.

The Tin Control

THE international tin control creates what is practically a buying monopoly. Such is, of course, just as justifiable economically as is a producing and selling monopoly and is just as much subject to the law of supply and demand. The immediate question will be whether the price that will be fixed will be sufficient to bring out the production that is wanted. In this connection there are many subordinate questions.

Tin production differs from that of the other major metals in that large mining companies figure to a much less extent. Tin comes in small quantities from a great many sources, chiefly in scantily developed countries and largely from the workings of natives—Malays, Chinese and negroes. The value of silver plays a great part in their finances, a high price for tin meaning much less to them with a high price for silver than when exchange is more favorable to them. Another question is that of satiety, that is, the point where a native may earn so much money in a few days that he sees no reason for working during the remainder of the week; wherefore with increasing prices aggregate production may actually decline. We have witnessed something similiar in the recent behavior of our own workingmen.

Another interesting and important subject is the handling of the Bolivian output, which is practically all

in the form of ore, to be smelted abroad. It is understood that the governments are to buy this on their own accounts and divide it among their smelters for conversion into metal on the basis of a fair profit. This plan will be hailed with joy by the Bolivian mine owners, who will attain their desideratum of a stabilized high price. It will be welcomed by the smelters, who have been very reluctant to buy ore supplies or enter into contracts on the inflated basis of late. It ought to stimulate Bolivian production, owing to both the foregoing reasons, individually and jointly, which also is something to be desired. It may some day cause the governments to hold an unsold stock of dear tin, on which they will have to pocket a loss, but nobody will think of crossing that bridge yet.

National Exposition of Chemical Industries

AT THE Fourth National Exposition of Chemical Industries, held during the week of Sept. 23, at the Grand Central Palace, New York, more than 350 exhibitors contracted for the entire exposition space on the three floors available for the purpose. This is an excellent measure of the activity and the importance of our youngest industry, for although there has been for a long time a chemical industry in the United States, it has neither attracted the attention, nor has it approached in magnitude, our other large industries. We are at the beginning of the larger development of this important industry. Though we have produced many raw products, have wasted untold quantities of valuable compounds in the smoke of our beehive coke ovens, have failed to utilize natural products that are available, the stimulus of a harsh war has brought us to a full realization of the necessity of placing our country on a self-contained basis.

Except in a few lines, such as the manufacture of common chemicals, fertilizers, explosives, rubber, photographic chemicals, borax, soda, phosphates and petroleum products, the business of the chemist has been that of an analyst and control man. The instruction in our colleges covered rather the elementary phases of chemistry than the business of manufacturing and selling chemical products. A few of the larger colleges developed courses in engineering chemistry, in anticipation of the future need that was apparent to the more far-seeing. Financiers were slow to appreciate the importance of assistance to the chemist optimistic enough to attempt to embark on a chemical manufacturing enterprise. Chemists themselves, well trained as laboratory men and thoroughly grounded along theoretical lines, lacked the experience in organization, mechanical design and business affairs to successfully undertake manufacturing. Though many ventures were failures, others were successful and progress was made.

The dependence of the chemical industry upon mechanical appliances is not realized by most engineers and business men. Nor are they familiar with the fact that our manufacturers and designers lead almost all other nations in crushing, grinding, leaching, evaporating, agitating and filtration devices. Acid-resisting materials and pipe, fittings, pumps and other apparatus finding special application in chemical manufacturing are available in great variety in our own markets.

In discussions of the war and its influence, it is not uncommon to hear expressions that this or that good will be accomplished. This is the only satisfaction that we can get out of the contemplation of the destruction and sorrow resulting from the struggle. When we look critically at the situation we see that the necessities of the moment have driven us to do in an incredibly short time what under ordinary circumstances would have required a decade or more. Things move rapidly in America, but the war has trebled and quadrupled our pace. War has brought our chemists, raw materials and mechanical industries into line. Where financial backing has been slow to come into the game, the Government has taken hold. Private enterprise has been the leader, nevertheless, and patriotism has been as much an incentive as the desire for gain, if not a greater one.

We hope that many mining engineers and metallurgists have visited the exposition, for they will have found in a compact space rare and common products manufactured from the minerals and ores that many of them produce from the mines and plants in their charge. A greater perspective and a larger appreciation of many possibilities will come from closer acquaintance with the work of our chemical manufacturers and the chemical industry.

The Fourth Liberty Loan

AS THIS paper reaches the hands of our readers, the drive for the Fourth Liberty Loan will be well under way. There is little that has not already been said, but what has been said applies now with even greater force. The mining industry has carried its share of the previous loans. It will carry its share of this loan. Give, is the order of the day. We make sacrifices in men and goods for a cause, a most worthy cause. Let every miner, worker, superintendent, engineer and manager get into the work of increasing the total of the subscriptions in his locality. Do Your Part.

Copper and Cotton

THE Rubicon has been crossed. The price for cotton is to be fixed, which means that it is to be fixed downward. The Southern senators vociferously protested against any laying of hands on their sectional commodity. They shouted that the law of supply and demand ought to prevail. As to that, many agree with them, but it was becoming too much of a scandal that cotton alone should be free while all of the other great basic commodities were regulated.

Now comes the question as to what the price for cotton shall be. We hear arguments and representations that are very reminiscent of the controversy over the copper price. There is no more use in going into studies of the cost of production in one case than there was in the other. We offer a solution of the problem that is very simple. Let the price for cotton be the same as the price for copper, 26c. per lb. at present. If the price for copper be raised or lowered, let the same happen to cotton. The normal ranges of these commodities are not dissimilar.

Personals

Have You Contributed to the Association of the 27th Engineers?

A. N. MacKay has been in New York since Sept. 16.

John L. Malm, of the Malm-Wolf Co., is in New York on professional business.

Franklin W. Smith is making an examination in the vicinity of Parral, Chihuahua, Mexico.

David A. Herron, general manager of the Tomboy Gold Mines Co., Ltd., is in Denver.

R. A. Bryce, of Toronto, Ont., is examining properties in the Gowganda, Ont., district.

F. G. Stevens, of Toronto, Ont., has been inspecting the Rex gold mine in northern Ontario.

John W. Sharpe, of Los Angeles, Calif., is making a reconnoiter of the Batesville, Ark., manganese field.

W. J. Prowell, representing a steel company of Detroit, Mich., has been in Arizona looking for manganese.

Basil Prescott will visit Santa Eulalia, Chihuahua, Mex., in October to make a geological examination.

Frank Kennedy, chief engineer for Butler Brothers, at Nashwauk, Minn., has resigned to go into business at Duluth.

Marion L. Thomas has returned to New York from Cuba, after a six weeks' investigation of manganese and iron mines.

J. W. Moffett has resigned as manager of the Beaver Consolidated Mines, Ltd., Cobalt, Ont., and is succeeded by **L. W. Ledyard.**

C. W. Whitley, general manager of the American Smelting and Refining Co. in Utah, has been on the Pacific Coast for a short vacation.

Mark Workman, president of the Dominion Steel Corporation, has gone to Sydney, N. S., and will remain at the plant for some time.

M. J. O'Brier, of Renfrew, Ont., a prominent Canadian financier and extensively interested in mining, has been elected to the Canadian Senate.

A. H. Rogers, of the firm of Rogers, Mayer & Ball, has recently returned from a six weeks' professional trip to British Columbia, Colorado and Missouri.

Bulkeley Wells, governor of the Colorado chapter of the American Mining Congress, has been elected a member of the national board of directors of the congress.

C. A. Fliteau, of the National Mines, Ltd., Cobalt, Ont., has been appointed manager of the flotation plant of the Peterson Lake Silver Cobalt Mining Co., at Cobalt.

L. S. Cates, general manager of the Ray Consolidated Copper Co., is spending much of his time at Phoenix, on the draft appeal board of the northern Arizona district.

Francis A. Thomson, dean of the Idaho School of Mines at Moscow, Idaho, is examining two antimony properties on Pine Creek, in the Coeur d'Alenes, for the Government.

Prof. S. F. Kirkpatrick has resigned his position at Queen's University, Kingston, Ont., to accept a metallurgical position with the Deloro Mining and Reduction Co., of Ontario.

Capt. Stewart M. Thorne, formerly manager of the Trethewey Mine, Cobalt, Ont., who has won both the Military Cross and the Croix de Guerre, was recently wounded in France.

Frederick L. Hoffman, statistician for the Prudential Life Insurance Co., spent five days in the Black Hills of South Dakota during September, investigating mining conditions.

Francis N. Flynn, formerly general superintendent of the smelting and refining departments of the Consolidated Mining and Smelting Co. of Canada, Ltd., is in New York.

F. H. Skeel, mining engineer of Wallace, Idaho, has been ordered to report at Washington for service in the engineer corps of the Army. He expects to be commissioned soon.

J. W. Morrison, formerly manager of the Lake Shore Mines, Ltd., Kirkland Lake, Ont., has been appointed manager of the Howie-Cochenor property in the Lightning River district.

J. H. Williams, who has been employed as an engineer at the Hawkins mine at Nashwauk, is to be superintendent at the Sargent mine at Keewatin, for the Wisconsin Steel Company.

Horace F. Lunt, of Colorado Springs, Colo., has been commissioned a captain of engineers and has been ordered to the Student Engineer Officers' Training School, Camp Humphreys, Virginia.

Frank Cochrane has been appointed by the Canadian government to be acting secretary of state and minister of mines during the absence of **Martin Burrell,** who is taking an extended vacation.

James P. Porteus has again taken charge of the Bonney mine at Lordsburg, N. M., as general superintendent for the Bonney Mining Co., the lease of the Lawrence Mining Co. having expired.

A. R. Globe, formerly assistant general manager of the Hollinger Consolidated Gold Mines, Ltd., at Porcupine, Ont., is in charge of operations on an iron property near Sellwood, Ont., in the Sudbury district.

David Cole has been making a visit of inspection to a number of districts in the Southwest, having been called to Arizona to attend a meeting in Prescott of the Arizona-Binghampton Copper Co. directors.

E. R. Abadie, Jr., formerly with the Empire Mines and Investment Co., of Grass Valley, Calif., is now superintendent of the Golden Center mine of the Grass Valley Consolidated Gold Mines Co., of the same place.

N. H. Darton investigated the stratigraphy of the "Red Beds" in New Mexico during August and September. The work was for the U. S. Geological Survey, to determine the prospects for locating potash deposits.

Charles E. Addams, formerly manager of the Arizona Hercules Copper Co., is devoting himself to the management of the Arizona State Council of Defence, of which he is executive chairman, and is now studying the work of the California Council of Defence.

Norman Carmichael, general manager of Arizona Copper Company, Ltd., at Clifton, has accepted appointment as chairman of the United War Work Campaign for the state and is in Phoenix organizing his forces, which include many of the well-known mining operators of Arizona.

David W. Brunton has been placed in charge of an enlarged Washington office of the Naval Consulting Board, which will be in Room 3547 of the new Naval Building. He will handle all communications and inventions. The office of the chairman and secretary of the board will continue to be maintained in New York.

A. E. Wells, of the U. S. Bureau of Mines, has been promoted to the position of metallurgist in charge of non-ferrous metals for the Bureau. He will act as chief metallurgist during the absence from Washington of that official. **C. E. Julihn** has been appointed superintendent of the Lake Superior experiment station. **Thomas Varley** has been transferred from the Seattle station and made acting superintendent of the Salt Lake City station. **F. F. Ovitz** has been made superintendent of the Seattle station.

Obituary

William Kent, the eminent mechanical engineer, died at Gananoque, Ont., on Sept. 18, aged 67 years. He was born in Philadelphia in 1851, was graduated in 1876 from Stevens Institute of Technology, and became editor of the "American Manufacturer and Iron World," in 1877. From 1879 to 1890, Mr. Kent was employed by various companies in the capacity of mechanical engineer, and from the latter date practiced as a consulting engineer. He became associate editor of "Engineering News" in 1895, which position he held until 1903, when he became dean of the L. C. Smith College of Applied Science, of Syracuse University, where he remained for five years. He returned to editorial work in 1910, when he accepted the position of editor of "Industrial Engineering," which he filled until 1914. Mr. Kent was probably best known among engineers of all branches of the profession as the author of the "Mechanical Engineer's Pocket Book," which he brought out in 1895. Other works were the "Strength of Materials," "Strength of Wrought Iron and Chain Cables" and "Steam Boiler Economy." Mr. Kent had lectured on engineering at many colleges and technical schools and had taken out over 20 patents on various mechanical appliances. He was a member of many engineering societies and was vice president of the American Society of Mechanical Engineers from 1888 to 1890. In former years, Mr. Kent was a rather constant contributor to the "Engineering and Mining Journal," many papers carrying his signature appearing therein 25 or 30 years ago.

Societies

American Iron and Steel Institute. The board of directors decided on Sept. 16 to omit the general meeting of the institute usually held in October.

Mining and Metallurgical Society of America. At a meeting of the council held on July 9, 1918, it was resolved that the "Gold Medal for 1919" shall be awarded for distinguished service in the metallurgy of iron and steel.

American Electrochemical Society will hold its 34th general meeting at Atlantic City, N. J., from Sept. 30 to Oct. 2. Among the papers to be presented are the following: "Hardness of Soft Iron and Copper Compared," by F. C. Kelley; "Relative Volatilities of Refractory Materials" by W. R. Mott; "The Electric Furnace After the War," by F. A. Fitzgerald; "The Future of Electric Steel," by J. A. Mathews; "Electric Pig Iron After the War," by Robert Turnbull; "The Government and the Technical Man After the War," by F. A. Lidbury; "The Power Situation After the War," by C. A. Winder; and "Research After the War," by W. D. Bancroft.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Amalgamator. James Hutchings, Chicago, Ill. (U. S. No. 1,276,656; Aug. 20, 1918.)

Blast Furnaces, Machine for Tapping. Benjamin J. Mullen, Leetonia, Ohio. (U. S. No. 1,276,251-252; Aug. 20, 1918.)

Concentration of Zinc, Lead and Other Ores, Process of. Robert G. Hall, St. Louis, Mo. (U. S. No. 1,276,058; Aug. 20, 1918.)

Concentration—Rubber Set Riffle for Tables. Joe Horn, Ray, Ariz. (U. S. No. 1,276,529; Aug. 30, 1918.)

Electrolytes, Process of Treating Impure. Frank T. Smith, Jamaica Plain, Mass. (U. S. No. 1,276,130, Aug. 20, 1918.)

Electrolytic Tank, Conductor Bar for. Julius H. Gillis, Anaconda, Mont., assignor to Anaconda Copper Mining Co., Anaconda, Mont. (U. S. No. 1,276,208; Aug. 20, 1918.)

Furnace, Apparatus for Charging Electric. Frederick T. Snyder, Oak Park, Ill. (U. S. No. 1,276,586; Aug. 20, 1918.)

Hoist. Edward Stout, Brighton, Iowa. (U. S. No. 1,276,281; Aug. 20, 1918.)

Hydrometallurgy — Extracting Soluble Metals from Ores. Charles Biesel, El Paso, Tex. (U. S. No. 1,276,162; Aug. 20, 1918.)

Mine-Car. Martin S. Runsvold, Bisbee, Ariz. (U. S. No. 1,276,148; Aug. 20, 1918.)

Mine Hoist, Recording Apparatus for. George F. Rover, Wilkes-Barre, Penn., assignor of two-thirds to Jennie H. Webb, Pittsburgh, Penn. (U. S. No. 1,275,605; Aug. 13, 1918.)

Mine Shaft, Safety Gate for. Walter Hardie Finley, Fairmont, W. Va., assignor to Fairmont Mining Machinery Co., Fairmont, W. Va. (U. S. No. 1,276,199; Aug. 20, 1918.)

Shafts, Concrete Lining for. Allen B. Dowell, St. Louis, Mo. (U. S. No. 1,275,874; Aug. 13, 1918.)

Steel, Process for Hardening. John W. Gilbert, Windsor, Vt., assignor of one-half to Daniel H. Parker, Windsor, Vt. (U. S. No. 1,275,242; Aug. 13, 1918.)

Zinc. Melting Apparatus. Takekichi Aramaki, Kiku-Gun, Fukuoka-Ken, Japan. (U. S. No. 1,275,196; Aug. 13, 1918.)

Zinc Powder, Explosive Containing. Frederick Geoffrey Lees Johnson, Chelsea, London, England, assignor to Palmer-Perchlorate Powder Co. of Canada, Ltd., Montreal, Can. (U. S. No. 1,276,537; Aug. 20, 1918.)

Editorial Correspondence

DENVER—Sept. 18

Consolidation of Clear Creek and Gilpin Counties has been proposed by prominent resident taxpayers. It is pointed out that now is an opportune time to consider the consolidation of these counties under a suitable name, with a new county seat and a single set of county officials. The two counties are among the smallest in Colorado, and considering the rapid decrease in population, the falling off of mining operations, the fact that more than 55% of the total area of the two counties is now in the forest reserve, and that an additional area is to be withdrawn forever from taxation and development by the creation of the proposed Denver National Park, the maintenance of two county governments over the remaining small area at the expense of the property holders and taxpayers is hardly justified at this time. As a result of such consolidation the amount of money now raised in the two counties by taxation could be reduced about 60%. Clear Creek County has an area of 249,600 acres, or 390 square miles, and Gilpin County contains 184,480 acres, or 288 square miles. The assessed valuation of Clear Creek in 1916 was $5,-143,640, whereas that of Gilpin was $3,453,-641. The amount of money raised by taxation for state, county, town, and school, purposes in 1916 was $138,782.71 for Clear Creek, and $102,416.08 for Gilpin, a total for the two counties of $241,198,79. Average levy in 1916 for Clear Creek was 26.98 mills, and for Gilpin 29.71 mills, nearly double the rate of any of the other counties in the north central part of Colorado. Politicians in the two counties, who are the greatest beneficiaries of the present arrangement, will no doubt strenuously oppose the scheme of consolidation. Efficiency and economy seem to favor the plan. With a few exceptions most of the production from the mines in Clear Creek and Gilpin counties is now made in relatively small lots, mined by lessees and sub-lessees. Scarcity and high cost of labor and the increase in the cost of mining supplies have resulted in the shutdown of all but a few of the more substantial operating companies.

Producers of Metals and Coal who have lost men essential to maximum production may secure the release of these men from Army service, according to a recently promulgated order, if the men will accept furloughs and will return to their employment. The Bureau of Mines will assist metal producers to secure results. Furloughs are granted under the following conditions: The employee who has been taken must have been employed in a position demanding technical knowledge, or have been a skilled operative in some department where it is difficult to place new and untried men; the mine or industry must have been listed as an "essential" by the Priorities Board; the employee must be willing to accept furlough and return to his employment without coercion. The man on furlough will be excused indefinitely from military service and will draw civilian pay, but will retain his uniform and must be subject to call from the War Department. If furlough is granted, the soldier retains all military rights and privileges of a soldier and also retains his established military rank. In applying for the release of an employee, the employer must address the Bureau of Mines, stating the circumstances of each man, his value and record. If satisfied that the case should receive attention, the Bureau, through its certifying officer, will at once forward the necessary blanks to be filled out by the employer or agent of the company. Affidavits and necessary evidence must be submitted to the Bureau, and that organization will make any necessary investigation, including personal investigation of the attitude of the employee. If the result is satisfactory, the certifying officer will at once request the release of the employee, and furlough will issue. Up to this time the order has been exercised only in the case of employees of shipyards, munition plants and like essential labor. Recently it was placed in active operation in the Fuel Administration, and hundreds of coal miners, superintendents and skilled men in producing mines have been returned. On Sept. 5 the order was taken up by the Bureau of Mines and is in the hands of a committee composed of H. Foster Bain, assistant director; C. W. Merrill, mining engineer, and J. E. Spurr, in charge of war-mineral investigations. Mr. Spurr is acting chairman. The handling of all problems regarding unskilled labor in metalliferous mines has been placed in the hands of the Bureau of Mines. Complaints regarding labor shortage in metalliferous mines should be addressed to this committee.

SALT LAKE CITY—Sept. 19

The Purchase of the Yampa Mine by the Utah Consolidated at Bingham has come about largely as the result of the litigation pending between the two companies, due to the filing of suit for trespass against the Yampa by the Utah Consolidated, whose territory entirely surrounds the Yampa. At the time of filing the above-mentioned suit, the Utah Consolidated instituted similar proceedings against another neighbor, the Utah-Apex. During its period of greatest productivity, the Yampa, which has been idle for some time, had an output of from 4,000,000 to 6,000,000 lb. of copper yearly. It operated its own smeltery, situated in Bingham Canyon, but never made any great profit from its ores. After a time, work at the smeltery was abandoned and the mine continued to operate and shipped to other plants. The smeltery was dismantled and sold for junk.

Experimenting With Utah Oil Shales continues in an effort to arrive at methods of profitable treatment. A number of experimental plants have been built and a large acreage of oil-shale lands has been incorporated, but so far no commercial plants have been built. The point of departure is, of course, the Scotch method of distillation, although the nature of the oil shales in this country is not sufficiently similar to permit of exact imitation. The Western shales are much more heavily saturated, and the effort here is toward the production of gasoline rather than toward that of burning oil. The operations in Scotland also are on a comparatively small scale, and the deposits not so extensive. The exploitation of the American shales will probably mean steam-shovel work and large-scale operation. For a time a small experimental plant designed by Otto Stahlman, of Salt Lake, was in operation at the University of Utah. Another method is the Crane process. At present one of the two experimental plants operating here uses the Jenson process and the other the Erickson process. The Jenson plant is a three-stage horizontal reduction plant, and has been operating for the last six months, making experiments on oil shales from Utah and surrounding states. In the field it is planned to use as many as 12 superimposed horizontal cylinders. The Erickson process also employs a multiple system of removing vapors, using vertical cylinders, and the plant built for experimentation along these lines has a capacity of 12 tons daily. A trial run of 24 hours was made recently. The ultimate object, as in the case of the plant using the Jenson process, is the building of a larger plant in the field.

PHOENIX, ARIZ.—Sept. 20

The Copper Queen Branch of the Phelps Dodge Corporation and the Calumet & Arizona Co. are offering inducements to steady miners who wish to own their own homes. They are preparing to build more than 200 homes for married men in Warren townsite. The lots are 65 ft. wide, and provision has been made for shade and shrubs and for water for irrigation.

Copper Production in Arizona is bound to suffer through the inroads of the draft upon mine and office men, although many have already gone as volunteers, mainly in the engineer regiments. At present there is sharp complaint from the mine foremen that a large number of their skilled miners have gone to war-work plants in the East, classed as laborers, drawn by the lure of a change and the prospect of wages at least as large as they have been drawing in Arizona. The complaint has been accepted as just by the Federal Labor Administration, which has ordered that strict investigation be made, to the end that no more miners be shipped to laborers' jobs outside of the state.

JOPLIN, MO.—Sept. 16

Concentrating Plants in Operation or ready for operation in the Oklahoma section of the Joplin mining district now total 202, and 30 are under construction. In addition, there are 10 plants where hand jigs are being used, some of them producing a carload of ore a week or more. Recently the work of building new mills has been cut down appreciably, and after those plants that were contracted for some months ago are completed, it is expected that no new mills will be built until ore prices improve.

BATESVILLE, ARK.—Sept. 16

Washing Plants in the Batesville Field, construction of which was begun earlier in the year, are now being placed in operation. Until the apex of the present development is reached, a number of plants will be started each month, with a corresponding increase in the production of the field. The 200-ton plant at the Allen mine, which is owned by J. C. Shepherd and associates, was started early in September. It consists of a combination log washer and jig plant. The crude ore is delivered to the plant from the mine, 1000 ft. up the mountain, by a 12-in. flume and is washed down. During this process the clay in the gangue is practically removed before the crude ore reaches the washing plant proper. The property is incorporated as the Leader Mining Co., with J. C. Shepherd, president; O. M. Bilharz, vice president and E. G. Burnley, secretary and treasurer. The Waco Mining Co., operating across the Polk Bayou from the Allen, has a large washing plant almost completed. Independence Mining Co., owning the Polk-Southard mine, near Cushman, and other properties in the field, has completed the erection of a washing plant at the Polk Southard mine and will start operations as soon as the pumping plant is installed. Two steam shovels have been working at this property, and nothing but nugget ore has been produced. In mining this ore there has been taken out a large tonnage of crude wash-ore, which will be treated in the new washing plant. E. C. McComb, president of the company, also states that he has machinery ordered for a small washing plant to be installed at Penters Bluff, to handle wash dirt from several properties there. The Oklahoma-Kansas Mining Co., operating in the Miami district of the Oklahoma zinc field, has purchased the Denison and Schlieper properties and contemplates the erection of a number of washing plants. The Standard Manganese & Wire Co., of Chicago, is completing a washing plant at Lafferty Creek, which will consist of two 32-ft. log washers, with necessary screens and conveyor belt and a 2500-ft. flume, through which the crude ore will be moved from the mine to the plant. In addition the company has built good roads and substantial bridges. Eureka Manganese Mining Co. has installed the first modern washing plant in the field and is now enlarging its capacity by increasing the water supply. W. H. Beaty, who is in charge, states that the company will install two 200-ton washing plant on the Napoleon-Hill tract, which lies between the Eureka mine and Cushman. Machinery has been ordered. New operators are still coming into the field. Plans for new hotels at Batesville and Cushman are under way. Production during the first eight months of 1918 was 13,222 tons, of all grades. With the increased tonnage which will result when the new washing plants begin operation, the production for 1918 should show a gain over last year, which was in excess of 16,000 tons, of all grades.

DULUTH, MINN.—Sept. 21

Petitions Have Been Filed in the United States District Court by the Shenango Furnace Co. charging that extravagance is rife in the village of Buhl and asking that warrants of that village be withheld, and by the Pitt Iron Mining Co. against the village of Mountain Iron, preferring similar charges. Hearings for both petitions are set for Sept. 21 in Minneapolis.

and Judge Norris has granted temporary restraining orders against the villages. It is charged that both villages have issued warrants above the amounts permitted by law.

The Ore-Shipping Season on the Mesabi will come to a close in another month or six weeks. In general, mining operators are well up with their work, and at the mines which have a definite quota for shipment during the year, the requirements will be met. Some superintendents report that they are already beyond their apportionment for this time of the season and others that they will need all possible labor and energy to complete the required demands. With still other operators, an unlimited amount may be shipped. Generally the season has been favorable, despite the usual shortage of labor and the uncertainties of material. The next month or six weeks will determine what the shipments for the season will be, but in most places there is a feeling of satisfaction that the Mesabi has done its part and done it well.

HOUGHTON, MICH.—Sept. 16

The Action of Copper-Mining Companies in seeking exemption for employees is not only justified but is positively necessary if the production of copper is to be kept to a figure that will meet the requirements of the Government, domestic and Army needs, and of the Allied governments. The companies do not purpose asking for a blanket exemption for all of their employees. The local exemption boards and the district board will undoubtedly agree that the necessary employees of mining corporations must be kept at work and that their work is quite as essential as fighting in the trenches. The Michigan copper-mining district already has given at least 30% more than its share of soldiers, including the volunteers who went with the state organizations, one company of militia for infantry service, another company of naval militia and three companies of engineers, to say nothing of the hundreds that went individually and of whom there is no toll. The total is unusually large in proportion to the population. There is no argument on the question that further depletion of the mines would put a deficit in production for the remainder of the year, as it already has for the last few months.

SPOKANE, WASH.—Sept. 20

Satisfactory Construction Progress is being made on the power lines from Bonnington Falls, B. C., to the smeltery and other industries at Northport, Wash., and to the mines on Copper Mountain, B. C. The lines are being installed by the West Kootenay Power and Light Company, a subsidiary of the Consolidated Mining and Smelting Co. of Canada. Their cost is estimated at upward of $1,000,000. The line to Copper Mountain will carry 100,000 volts and the one to Northport, 60,000 volts.

That Lack of Transportation and nothing else is responsible for the inappreciable production of lode gold in central Idaho at a time when the metal is so sorely needed is the opinion of Francis A. Thomson, dean of the school of mines of the University of Idaho, who spent most of August making a survey of the districts of Idaho County, which he estimates have produced in the past between $100,000,000 and $150,000,000 in placer gold. He says the district is second only in modern times to the placers of California, Fraser River, Australia and Alaska. Although mined for nearly 60 years, the district is so mountainous that the state and county have not felt justified in building into a section largely in forest reserves. Mr. Thomson urges the Government to construct a motor road into the camps.

TORONTO—Sept. 21

Recently Reported Potash Discoveries in old lake bottoms north of Maple Creek, Sask., have resulted in a rush of prospectors to that section. Numerous alkali sloughs in that district have been staked out, and many samples were being collected for analysis.

VICTORIA, B. C.—Sept. 16

Export of Canadian Silver Coin, silver bullion and fine silver bars is prohibited except under license issued by the Minister of Finance. The regulations provide that licenses shall be issued only where the silver is to be used for civil or military purposes of importance in connection with the war and only in cases where the exporter certifies that it has been purchased at a price which does not directly or indirectly exceed $1.01½ per oz., 1000 fine, at the point where the silver is refined or at the point of importation in the case of imported silver.

The Mining News

ALASKA

ALASKA SHIPMENTS of domestic copper, ore and matte to the United States during August were 8404 gross tons, having a copper content of 4,245,557 lb. and valued at $1,093,306.

ARIZONA

Cochise County

LOS CONQUISTADORES (Benson)—Three shafts on the property are 115, 118 and 80 ft. deep respectively. Formation which carries the gold is quartz contained in diorite, pegmatite and schist dikes. Mine equipment consists of a complete mill building, assay office, and headframe for hoist at the 115-ft. shaft.

Mohave County

HACKBERRY CONSOLIDATED (Hackberry)—Mill to start in 60 days.

BERKELEY (Kingman)—New shaft down 40 ft. and in ore. Drifting from old shaft on 100 level in ore.

WALNUT CREEK (Kingman)—Tunnel to tap main copper vein at 750 ft. has been driven 600 ft. and has cut several stringers of rich ore.

RECORD LODE (Oatman)—Shaft down 433 ft. J. J. McCarthy is superintendent.

Pinal County

RAY CONSOLIDATED (Ray)—Copper production during August amounted to 6,625,000 pounds.

SILVER KING (Superior)—Carload of rich silver ore shipped from raise from the 400 level.

Yavapai County.

ARIZONA-BINGHAMPTON (Agua Fria)—Larger shaft to be sunk.

BELFORD (Mayer)—Taken over by Little Egypt Co. Property has 18 claims. Machinery for development has been ordered.

SHEA (Verde)—Shipments to be started soon to United Verde Extension furnaces. Ore is siliceous.

BIG DOME (Walker)—Struck heavy flow of water.

Yuma County

COBRITA VERDE (Cunningham Pass)—Work to be resumed soon as well as on a number of other shallow properties where miners cannot be secured during the hot season.

LITTLE GIANT (Cunningham Pass)—Operated by the Black Giant Co. of Mobile, Ala. Shipping a carload a week of copper and gold ore, stoped mainly on the 200 level.

ARKANSAS

Independence County

EDWARDS (Batesville)—Development work in progress and good production being maintained. Operations carried on by shafts, pits and open cuts.

GROSSMAN (Batesville)—A. Grossman, of Chandler, Okla., has purchased 200 acres of manganese land in Sullivan Creek district. Working from 20 to 30 men, and from 8 to 10 teams.

JOHN MARTIN (Batesville)—Tract consists of 160 acres of Lafferty Creek. Small force mining 10 to 20 tons a week, with pick and shovel.

STORY (Batesville)—Purchased by Chicago interests through A. J. Edwards. To start construction of $40,000 washing plant this month. Tract consists of 80 acres and is partly developed.

CALIFORNIA

Amador County

BUNKER HILL (Amador City)—Recent development in crosscut and drifts has disclosed pay ore in lower levels, and stoping was started. To resume milling soon.

ARGONAUT (Jackson)—California Mines Concentrating Co. installing cyanide plant to work tailings. Tanks are built of concrete. Storage capacity, 160 tons of solution. W. E. Darrow, manager of concentrating company, successfully cyanided Bunker Hill tailings.

CENTRAL EUREKA (Sutter Creek)—Shaft now sunk to 3555 ft. and good ore coming from 3500 level, supplying 20 stamps. Raise driven from 3500 to 3400 level to connect with raise to 3200 level providing ventilation and showing good prospects of ore. Albion S. Howe is superintendent.

LINCOLN (Sutter Creek)—Dismantling old plant for scrap. Mine formerly large producer, now owned by Eastern men associated with owners of Old Eureka. Reopening and development to be undertaken.

Butte County

CHROME DEPOSIT discovered on Mill Creek, two miles east of Pulga, by J. G. Dwyer, of Oroville, to be operated by San Francisco men, after shipment of 100 tons now ready.

Calaveras County

UTICA (Angels Camp)—Operation suspended at the Cross shaft. Gold Cliff producing regularly.

Eldorado County

PACIFIC (Placerville)—Aleander Baring recently visited mine to arrange for reopening. Old property, developed by shaft and situated in the center of town.

Lassen County

ALLEN & ECKERT (Susanville)—High-grade gold-silver ore occurring in narrow seams and accompanied by large body of low grade has been cut. New claims have been located along the formation, which is several hundred feet wide and of undetermined length.

Nevada County

ALLISON RANCH (Grass Valley)—Water at 900 level. Ore being extracted from levels above.

NORTH STAR (Grass Valley)—Installed 1225-ft. aërial cable operating a clamshell bucket to carry trailings across Wolf Creek.

QUAKER HILL GOLD (Nevada City)—Company formed to purchase and operate Sargent and Gouge-Eye hydraulic mines. To install large hydraulic plant.

CHROME MINING is active in Rough and Ready and Washington districts. Some of the ore concentrated at the Oustomah mill. Chicago Park district, two miles south of Grass Valley, also showing good chrome prospects, and some good ore has already been extracted.

Shasta County

GARDELLA DREDGE (Redding)—Recent 10-days' clean-up netted $4000. Dredge operating on old McCormick-Saeltzer ranch.

COLORADO

San Juan County

JOE & JOHN (Gladstone)—Recently purchased by G. H. Cook. Development has opened a vein of payable gold and silver ore. Trial shipments to be made to the Durango smeltery soon.

IDAHO

Shoshone County

AJAX (Burke)—Crosscut for vein east of Oom Paul fault soon to be abandoned and work transferred to drift west of fault, where considerable ore has been developed.

NABOB CONSOLIDATED (Kellogg)—Contemplates building mill upon completion of Pine Creek railroad.

THRONDSON METAL SAVING (Kellogg)—Completed 200-ton mill opposite mouth of Pine Creek. Treating accumulation of slime tailings, estimated at 450,000 tons. Mill equipment, concentrating tables and flotation; no crushing.

BEAR TOP (Murray)—Shipping lead-silver ore, hauling 12 miles to railroad. Company also controls Orofino group adjoining, which has 100-ton mill.

NORTH BUNKER HILL (Wardner)—Installing electric power to take place of gasoline. Two veins have been crosscut on 300 level. Preparing for extensive development.

MICHIGAN

Copper District

CALUMET & HECLA (Calumet)—Copper production in August was 10,718,520 lb. Producers were: Ahmeek, 1,636,040 lb.; Allouez, 472,550; C. & H., 5,197,541; Continental, 169,400; Isle Royale, 1,273,680; La Salle, 172,755; Osceola, 1,445,755; Superior, 144,659, and White Pine, 206,140 pounds.

CENTENNIAL (Calumet)—Old workings of No. 2 shaft caved down to first level, but no damage was done. No. 2 to be shut down temporarily.

SENECA (Calumet)—Shaft sunk 205 ft. during August. Has averaged 202½ ft. per month during sinking period.

HOUGHTON COPPER (Houghton)—Has suspended operations.

SUPERIOR (Houghton)—Drifting on 31 level is showing good copper rock.

WOLVERINE (Kearsarge)—Mill running two shifts and handling 800 tons of rock daily.

NORTH LAKE (Lake Mine)—Closed down owing to adverse conditions and breaking of hoisting rope.

COPPER RANGE (Painesdale)—Continuing diamond drilling at Challenge property. Champion, Trimountain and Baltic now producing 35% of normal output.

MICHIGAN (Rockland)—Has resumed shipments to Winona mill.

Iron District

MAITLAND MINING (Palmer)—Has begun shipments. Ore mined by steam shovel and crushed. Some hydraulic stripping has been done.

MINNESOTA

Mesabi Range

DANUBE (Bovey)—Guthrie Bros., stripping contractors, have removed one million yards of stripping and some ore tonnage will be shipped this autumn. One unit-washing and crushing plant is being built at Little Riley Lake. Mine operated by Balkan Mining Co. George Leach is superintendent.

SARGENT (Keewatin)—Stripping operations are conducted by Winston-Dear Co. Mine operated by Wisconsin Steel Co. Shaft has been sunk 150 ft., and skip pocket is to be cut soon. Mine dwellings and five mine buildings are under construction. J. H. Williams is superintendent.

MISSOURI

Joplin District

BALDWIN (Aurora)—Started operations after several months' idleness. Property includes a concentrator.

FARMINGTON (Hockerville)—Mill has resumed operations under new ownership.

LUCKY FRIDAY (Joplin)—Cut ore in new shaft on Connor land at 40 feet.

NEOSHO (Neosho)—To build 150-ton mill and expects to purchase crushers, compressors and conveyors. Work to start Oct. 1.

MONTANA

Cascade County

ANACONDA (Great Falls)—First furnace of ferromanganese plant blown in Sept. 17. Four more furnaces to be in operation by November 15.

Jefferson County

LEGAL TENDER (Clancy)—New company reopening 500-ft. shaft of former rich silver producer.

MT. WASHINGTON (Wickes)—Shipping one car of silver-lead ore per day.

Lewis and Clark County

LEE MOUNTAIN (Rimini)—After shipping 37 carloads of silver-lead ore, works have been closed.

Lincoln County

SNOWSTORM (Troy)—During August 5000 tons of ore handled by mill. Tunnel No. 7 has been driven 900 ft. and will have a total length of 2200 feet.

Mineral County

TARBOX (Saltese)—Winze from 800 level sunk 200 ft., from which crosscut is being driven 75 ft. to vein. Company may build mill this autumn.

Powell County

BALD BUTTE (Bald Butte)—New shaft of south vein has been sunk 200 feet.

VICTORY (Ophir)—Lessees cyaniding dump and tailings pile.

Silver Bow County

NORTH BUTTE (Butte)—Shaft on Sarsfield claim has been sunk over 900 ft., and connection with other properties will be made wher 1000-ft. point is reached.

TUOLUMNE (Butte)—Net earnings for August are estimated at $16,000, as compared with $6000 during July.

NEVADA

Elko County

OLD CORNUCOPIA DISTRICT is being reopened. High-grade silver ore recently found in Peacock mine, and considerable tonnage milling-grade ore is on dumps. Cornucopia was large producer of silver in the early days, but closed down 1893, and has not been reopened, on account of distance from railroad.

Humboldt County

NEW TUNGSTEN DISCOVERIES have been made near Rebel Creek, in Santa Rosa Range near north line of county. Discovery was made by W. T. Critchfield and B. Martin, who were developing a silver property and hauling out ore to railroad with auto truck.

Nye County

MANHATTAN CONSOLIDATED (Manhattan)—Shaft sunk to 500 level, where ore of good grade opened in lateral development work.

WHITE CAPS (Manhattan)—Mill treating over 100 tons daily. Mine pumps being put in condition to handle water anticipated in shaft.

TONOPAH DIVIDEND (Tonopah)—Equipped with modern plant, including hoisting engine, electric light plant and compressor. Main shaft is two compartment and 300 ft. deep. E. P. Cullinan is manager.

SOUTH DAKOTA

Lawrence County

TITANIC (Deadwood)—Compressor, boiler and machine drills have been installed and work has started on 1200-ft. tunnel.

MOGUL (Terry)—Mogul-Ofer tunnel has been advanced over 1200 ft. and will be continued to 1600. Ores from upper levels will be sent through raise to tunnel and then to bins at portal. Aërial tram will be used to deliver at mill bins instead of railroad cars.

Pennington County

AMERICAN TIN AND TUNGSTEN (Hill City)—Cowboy shaft unwatered and breaking of ore has begun. New double-drum hoist installed at mine. Mohawk and Mills mines also being developed.

BLUE LEAD (Hill City)—Boiler and compressor installed and shipping of copper ore has been resumed.

UTAH

Salt Lake County

SELLS (Alta)—New tram connecting bins near Lexington tunnel, with receiving station half mile down canyon, is ready for operation. Ore is lead-silver with a little gold.

UTAH COPPER (Bingham Canyon)—August copper production was 19,920,947 pounds.

Juab County

APEX STANDARD (Eureka)—Shaft 165 ft. deep is being cleaned out and retimbered preparatory to sinking to depth.

VICTORIA (Eureka)—Silver-copper ore of high grade being mined on 1050 level. Operated through Eagle & Blue Bell under same management.

CANADA

British Columbia

CANADA COPPER (Greenwood)—Construction of the concentrator is going forward actively.

RAMBLER-CARIBOO (Three Forks)—Output next year likely to be confined to ore of milling grade, as recent operations show little clean ore. Contemplating purchase of locomotive.

CONSOLIDATED MINING AND SMELTING (Trail)—Receipts of ore at smeltery for first eight months of 1918 totaled 223,610 tons.

GRANBY CONSOLIDATED (Vancouver)—Production during August amounted to 2,820,207 lb. of copper. Of this, the Anyox plant produced 2,426,313 lb. and the Grand Forks plant 393,894 pounds.

Ontario

DOME (Porcupine)—Development work principally on 1250 level, where a drift is being driven toward the east, and main haulage way for ore is being cut through rock.

NEWRAY (Porcupine)—Operations discontinued owing to labor shortage.

VIPOND (Porcupine)—Pumps have been withdrawn, and mine will be allowed to fill with water.

PREMIER LANGMUIR (Langmuir Township)—Several shipments of barite have been made, notwithstanding difficult transportation conditions. A siding to the railway is now being built.

HUDSON BAY (Cobalt)—Cut new high-grade vein parallel to the open cut.

KERR LAKE (Cobalt)—Silver production during August amounted to 250,319 ounces.

LA ROSE (Cobalt)—Has made important discoveries on the Violet claim. A new oreshoot is being opened up on No. 2 vein and a new series of veins have been found 250 ft. north of No. 2. Both of these are on the 330 level.

MINING CORPORATION (Cobalt)—Treating 300 tons of old tailings per day in the new flotation plant.

NIPISSING (Cobalt)—During August mined ore of a net value of $250,737, and shipped bullion from Nipissing and custom ore of a total net value of $484,978. Mill production was low, on account of shutdown of aërial tramway, owing to a fire.

OPHIR (Cobalt)—Shareholders have ratified agreement to option property to the Mining Corporation. Latter company has taken possession and is doing development work.

PETERSON LAKE (Cobalt)—Flotation plant has resumed operations.

PROVINCIAL (Cobalt)—To resume work upon arrival of flotation equipment.

BURNSIDE (Kirkland Lake)—To install new mill.

ELLIOTT-KIRKLAND (Kirkland Lake)—Started diamond drilling property from the 500 level. Development on the vein to date has been unsatisfactory.

KIRKLAND - PORPHYRY (Kirkland Lake)—Has taken over the Orr property.

LAKE SHORE (Kirkland Lake)—Treated 1800 tons, and produced bullion valued at $48,000, an average of $26.70 a ton, during August.

WRIGHT-HARGRAVES (Kirkland Lake)—Robert Grant is to design and supervise construction of a 150-ton mill.

HATTIE (Matheson)—Shaft sunk 25-ft. on four-foot gold-bearing vein. Arrangements being made to install mining plant.

OTISSE (Matachewan)—Additional equipment necessary for operation of the mining plant has been shipped, and sinking will start as soon as it is installed.

COTTER (Boston Creek)—Diamond drilling to be done by the Sudbury Diamond Drilling Co., which will start at once.

MILLER INDEPENDENCE (Boston Creek)—Shaft has reached depth of 200 feet.

O'DONALD CLAIMS (Boston Creek)—Has been leased by Robert W. Norrington and associates, of Detroit.

RENAUD CLAIMS (Boston Creek)—Surface work begun and good ore being taken out.

BOURKE'S (Bourke's Station)—Ore containing free gold and tellurides has been cut at depth of 95 ft. Drifting will begin at 100 level.

ASIA

Chosen

ORIENTAL CONSOLIDATED (Unsan)—August cleanings amounted to $93,500.

The Market Report

SILVER AND STERLING EXCHANGE

Sept.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Sept.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
19	4.7550	101⅛	49⅛	23	4.7550	101⅛	49⅛
20	4.7550	101⅛	49⅛	24	4.7550	101⅛	49⅛
21	4.7550	101⅛	49⅛	25	4.7550	101⅛	49⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Sept.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
19	*26	†	8.05	7.75	9.05 @9.15
20	*26	†	8.05	7.75	9.00 @9.10
21	*26	†	8.05	7.75	9.00 @9.10
23	*26	†	8.05	7.75	9.00 @9.10
24	*26	†	8.05	7.75	8.95 @9.05
25	*26	†	8.05	7.75	8.90 @9.00

*Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917, and July 2, 1918.

† No market.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis.

LONDON

Sept.	Copper Standard Spot	Copper Standard 3 M.	Copper Electrolytic	Tin Spot	Tin 3 M.	Lead Spot	Lead 3 M.	Zinc Spot
19	122	122	137	343½	343½	29½	28½	54
20	122	122	137	341½	341½	29½	28½	54
21								
23	122	122	137	341½	341½	29½	28½	54
24	122	122	137	340	340	29½	28½	54
25	122	122	137	.....	.....	29½	28½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at $4.7515: £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

New York—Sept. 25, 1918

Zinc was easier this week. Otherwise there is scarcely anything to report.

Copper—Europe is taking a good deal of raw copper and is asking for all the brass it can get. In this country there is scarcely any ordinary industrial business, copper manufacturing being about wholly on a war basis. Brass making consumes most of the copper. Wire drawers are fairly busy, but sheet rolling is practically negligent.

Copper miners and refiners are wondering how the draft is going to affect them. The advent of cold weather is producing better conditions in the refineries.

Copper Sheets—The base price of copper sheets remains at 35½c. per lb. Copper wire is quoted at 29 and 30c. per lb. f.o.b. mill, carload lots.

Tin—People in the tin business know scarcely more than they did last week as to how things are going to be conducted. It appears that the Dutch and Chinese interests are not represented on the international tin executive body. There have been no further quotations of the market in Singapore. The price for tin here has not yet been fixed.

In spite of the prospective arrangements, it seems possible to buy tin for shipment from Singapore, Straits tin for prompt shipment being offered at 72½c. On the other hand, Banka cannot be bought for September shipment from Batavia at less than 89c., while $1 is asked for shipments of Chinese tin from Hong Kong. In this market Banka is quoted at 81@83c.

Refer to our editorial pages for a further discussion of the tin situation.

Lead—The situation remains tight as ever and fully in control of the lead committee, which, under the direction of Mr. Crane, is doing excellent work. Both Mr. Crane and Mr. Mitchell are winning general commendation for their intelligence and diplomacy in handling a difficult situation. The Orient wanted to buy lead this week, but of course it could not be supplied with any.

Zinc—This market became distinctly easier on some fairly large transactions. It is significant that October-December and November-December contracts are offered at a discount of about ½c. below what is asked for prompt.

Zinc Sheets—Unchanged at $15 per 100 lb., less usual trade discounts and extras as per list of Feb. 4.

Other Metals

Aluminum—Unchanged at 33c. per lb.

Antimony—This market was quiet, but there was a very strong undertone. Unsold stocks still exist here, but the quantity cannot now be very large. The Chinese producers are strongly averse to selling any large quantities at present prices and let out only small quantities. We quote spot at 14@14½c.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.50 per lb. for wholesale lots—500 lb. and over.

Cadmium—This metal is quoted at $1.50 @1.75 per pound.

Nickel—Market quotation: Ingot, 40c.; shot, 43c.; electrolytic, 45c. per pound.

Quicksilver — This market became stronger, and considerable quantities were reported sold at around $129. We quote $127.50@130. There appears to be two conflicting parties in the market, a bullish and a bearish. San Francisco reports by telegraph $120, strong.

Silver and Platinum

Silver—The market continues stabilized for silver at 49⅛d. in London, with the official price here, $1.01⅛ per oz. 999. The demand for India continues; supplies for China are held back until the India situation is more satisfactory. London shipments in the last week were about 660,000 ounces.

The price for silver is rigidly controlled both here and in London. It looks as if China would give 12@15c. per oz. over the fixed prices. Recent exchange rates indicate that. However, she is not allowed to have it.

Mexican dollars at New York: Sept. 19, 78; Sept. 20, 78; Sept. 21, 78; Sept. 23, 78; Sept. 24, 78; Sept. 25, 78.

Platinum, Palladium and Iridium—Prices fixed at $105, $135 and $175, respectively.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 21—Blende, per ton, high $77.35; basis 60% zinc, premium, Class B, $65@60; Prime Western, $55@50; calamine, basis 40% zinc, $40@35. Average selling prices: Blende, $52.71; calamine, $37.97; all ores of zinc, $52.20.

Lead, high, $105.20; basis 80% lead, $102@100; average selling price, all grades of lead, $100.83 per ton.

Shipments the week: Blende, 9257, calamine, 331; lead, 1828 tons. Value, all ores the week, $684,910.

Offering of only $55 basis, with spelter above 9c., was considered an insufficient price by many sellers, and they declined to accept. The shipment dropped 2400 tons. A large amount of the ore in bins is, however, purchased and owned by smelters, who are apparently in no hurry to move it. This creates an impression of a reserve stock in excess of its actuality. Buyers of lead are contesting sharply for the production, and reports of prices higher than the reported basis would figure are frequent.

Platteville, Wis.—Sept. 21—Blende, basis 60% zinc, highest settlement price reported, $73.25; base price for premium grade, $75 per ton; base price for high-lead blende $50 per ton. Lead ore, basis 80% lead, $97 per ton base. Shipments reported for the week were 2222 tons blende, 402 tons galena and 727 tons sulphur ore. For the year to date the totals are 94,311 tons blende, 5783 tons galena and 35,288 tons sulphur ore. During the week 2870 tons blende was shipped to separating plants.

Other Ores

Chrome Ore—Distinctly weaker. Charles Hardy reports that ample supplies are being offered almost daily, and that the quantities seem to be far in excess of what the market can absorb. He adds that the bulk of the buyers of chrome ore have contracts covering their requirements until the end of the year.

Molybdenum Ore—Improvement that we noted last continues, and business was done this week at $1.20 to $1.25. Considerable business in ferromolybdenum was reported, which should strengthen the ore market. Sellers of ore are now holding for higher prices.

Pyrites—All licenses outstanding or unused for any part of the 125,000 ton allocation, made some months ago, unless previously extended by the War Trade Board, are to be cancelled as of date of Oct. 1. Prices of domestic pyrites are no longer quotable, as they are determined by negotiation between buyer and seller.

Tungsten—Market remains very active. High-grade scheelite sold for $25@25.50; high-grade wolframite $24@24.50; low-grade ores $19@24 per unit, according to amount and kind of impurity.

Iron Trade Review

PITTSBURGH—Sept. 24

At this writing the understanding reached between representatives of the War Industries Board and the iron and steel industry is awaiting approval by the President, and it is stated that secrecy as to details must meanwhile be observed. Gossip in the trade is that steel prices are unchanged for the fourth quarter, whereas Lake Superior iron ore is advanced 25c., which would make $5.75 for Mesabi non-bessemer at Lake Erie dock, and that basing points are arranged for pig iron whereby some furnaces will receive higher prices, depending upon freight rates.

Views expressed as to the supply of steel, both in Washington circles and in the steel industry, are extremely confusing. On the one hand claims are put forth that the steel supply is short, with 23,000,000 net tons of finished rolled steel estimated as required for the current half year, though only 9,000,000 to 10,000,000 tons has been made in the third quarter. On the other hand, various sources of consumption are being studied with the avowed purpose of finding lines in which the supply can be reduced. The consumers whose business is thus being inquired into comprise nearly all users of the product, including makers of shell steel, ship steel, pipe, wire, tin plate and merchant bars. Rails are the one item that it is definitely sought not to decrease, but rather to increase. The Railroad Administration has been receiving about 40,000 tons of rails a week lately, but wants 60,000 tons. Large shipments are being made to the A. E. F., but more tonnage is desired in that quarter also. There is, of course, no desire to curtail in the least the production of shells or ships, but the steel supplies to these and other consuming industries are to be more closely watched.

Production of steel hinges chiefly upon the pig-iron supply, and a larger proportion of pig iron than normal is required, because the available supply of scrap is light, on account of war-time conditions. The rate of pig-iron production since Apr. 1 has been between 40,000,000 and 41,000,000 tons a year, whereas the rated capacity of furnaces in blast is nearly 3,000,000 tons more, and the restriction in output is attributed chiefly to the poor quality of coke furnished, with occasional deficiencies in quantity. The Fuel Administration has been working hard in the last few weeks to bring about an improvement in coke quality, urging miners to produce clean coal and operators to produce good coke, and an inspection system has been established, and poor coke is to be penalized in price. One coke operator has been required to refund $80,000 to customers on account of poor coke which he has shipped, and another $75,000. The War Industries Board had a conference with pig-iron producers yesterday in Washington, seeking means to increase pig-iron output. If more pig iron is made there will be more steel.

Pig Iron—Allocations of pig iron are granted sparingly, as there is not enough to meet all requirements. At the pig-iron meeting mentioned above consideration was given to the matter of finding pig iron for the 33,000,000 semi-steel shells the Ordnance Department wants foundry and machine shops to make in the next 10 months, but no information is available as to what was done. There does not seem to be any consumption of foundry iron that is unessential and could be cut off. Deliveries of pig iron to the end of this month are controlled by prices formerly fixed: Bessemer, $35.20; basic, $32; No. 2 foundry, $33; malleable, $33.50; forge, $32, all f.o.b. furnace, but some modification of the schedule is expected to be announced for fourth quarter, possibly within a day or two.

Steel—No unfinished soft steel is available in the market, all supplies having been allocated long ago. Shell-discard steel is almost out of the market, because, as a rule, mills are able to roll it for war or preference purposes, and what cannot thus be used is likely to be remelted as scrap. Maximum prices, which are not likely to be altered for fourth quarter, are: Billets, $47.50; sheet bars and small billts, $51; slabs, $50; rods, $57.

Ferroalloys—Consumers of ferromanganese and spiegeleisen continue to show indifference, and generally appear to be covered as far ahead as they care to be. There have been rumors of slight concessions in prices under stress of competition. The long-continued scare about shortage may possibly develop the opposite condition. Regular prices are $250, delivered, for 70% ferromanganese and $75, furnace, for 16% spiegeleisen.

Coke

Coke—As noted, efforts are being made to improve the quality of coke. The quantity is practically at record rate, and apparently is sufficient to cover all furnace needs. Foundry coke is offered less freely, the Fuel Administration having required operators to ship as furnace coke some 72-hour coke they were selling to foundries which probably did not need it but were stocking up. Following the Fuel Administration's order prohibiting the screening of old dumps to secure household fuel, a tentative agreement has been reached whereby the industry will probably be allowed to proceed, under strict surveillance to see that it does not absorb coke-oven labor. The price limit on the product is reduced to $5.50, the screen size being reduced from ¾-in. to ½-in. Connellsville coke continues at $6 for furnace and $7 for foundry, per net ton at ovens. Byproduct coke is on the basis of $5.70 plus freight from nearest competitive beehive ovens to the point where the byproduct coke is made.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1916	1917	1918	1916	1917	1918
Jan.	56.775	75.630	88.702	26.960	36.682	44.356
Feb.	56.755	77.585	85.716	26.975	37.742	42.792
Mar.	57.935	73.861	88.082	27.597	36.410	43.620
April	64.415	73.875	95.346	30.662	36.963	47.215
May	74.269	74.745	99.505	35.477	37.940	48.980
June	65.024	76.971	99.500	31.060	39.065	48.875
July	62.940	79.010	99.625	30.000	40.110	48.813
Aug.	66.083	85.407	100.292	32.498	43.418	49.077
Sept.	68.515	100.740	.....	32.584	50.920	.....
Oct.	67.855	87.332	.....	32.361	44.324	.....
Nov.	71.604	85.891	.....	34.192	43.584	.....
Dec.	75.765	85.960	.....	36.410	43.052	.....
Year	65.661	81.417	.....	31.315	40.851	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1917	1918	1917	1918	1917	1918
Jan.	28.673	23.500	131.921	110.000	142.895	125.000
Feb.	31.750	23.500	137.895	110.000	148.100	125.000
Mar.	31.481	23.500	136.750	110.000	151.000	125.000
April	27.935	23.500	133.842	110.000	147.158	125.000
May	28.788	23.500	130.000	110.000	142.000	125.000
June	29.962	23.500	130.000	110.000	142.000	125.000
July	26.620	25.904	128.409	119.913	140.409	134.913
Aug.	25.380	26.000	122.391	122.000	137.000	137.000
Sept.	25.073	.....	117.500	.....	135.250	.....
Oct.	23.500	.....	110.000	.....	125.000	.....
Nov.	23.500	.....	110.000	.....	125.000	.....
Dec.	23.500	.....	110.000	.....	125.000	.....
Year	27.180	.....	124.892	.....	138.401	.....

Tin	New York		London	
	1917	1918	1917	1918
January	44.175	85.500	185.813	293.227
February	51.420	92.000	198.974	311.525
March	54.388	(a)	207.443	318.875
April	55.910	(a)	220.171	329.905
May	63.173	(a)	245.114	364.217
June	62.053	(a)	242.083	331.925
July	62.570	(a)	242.181	360.347
August	62.681	(a)	243.978	380.900
September	61.542	.....	244.038	.....
October	61.851	.....	247.467	.....
November	74.740	.....	274.943	.....
December	87.120	.....	298.556	.....
Av. year	61.802	.....	237.563	.....

(a) No average computed.

Lead	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	7.626	6.782	7.530	6.684	30.500	29.50
February	8.636	6.973	8.595	6.899	30.500	29.50
March	9.199	7.201	9.120	7.091	30.500	29.50
April	9.288	6.772	9.158	6.701	30.500	29.50
May	10.207	6.818	10.202	6.704	30.500	29.50
June	11.171	7.611	11.123	7.511	30.500	29.50
July	10.710	8.033	10.644	7.750	30.500	29.50
August	10.594	8.050	10.518	7.750	30.500	29.50
September	8.680	.....	8.611	.....	30.500	.....
October	6.710	.....	6.650	.....	30.500	.....
November	6.249	.....	6.187	.....	30.500	.....
December	6.375	.....	6.312	.....	30.500	.....
Year	8.787	.....	8.721	.....	30.500	.....

Spelter	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	9.619	7.836	9.449	7.661	48.329	54.000
February	10.045	7.814	9.875	7.639	47.000	54.000
March	10.300	7.461	10.130	7.286	47.000	54.000
April	9.459	6.890	9.289	6.715	54.632	54.000
May	9.362	7.314	9.192	7.114	54.000	54.000
June	9.371	8.021	9.201	7.791	54.000	54.000
July	8.643	8.688	8.473	8.338	54.000	54.000
August	8.360	8.935	8.190	8.635	54.000	54.000
September	8.136	.....	7.966	.....	54.000	.....
October	7.983	.....	7.813	.....	54.000	.....
November	7.847	.....	7.672	.....	54.000	.....
December	7.685	.....	7.510	.....	54.000	.....
Year	8.901	.....	8.813	.....	52.413	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1917	1918	1917	1918	1917	1918
January	$35.95	$37.25	$30.95	$33.95	$30.95	$33.95
February	36.37	37.25	30.95	33.95	30.95	33.95
March	37.37	37.25	33.49	33.95	35.91	33.95
April	42.23	36.15	38.90	32.95	40.06	33.95
May	46.94	36.20	42.84	33.00	43.60	34.00
June	54.22	36.36	50.05	33.16	50.14	34.16
July	57.45	36.60	53.80	33.40	53.95	34.40
August	54.17	36.60	50.37	33.40	53.95	34.40
September	46.40	.....	42.24	.....	48.5	.....
October	37.25	.....	33.95	.....	33.95	.....
November	37.25	.....	33.95	.....	33.95	.....
December	37.25	.....	33.95	.....	33.95	.....
Year	$43.57	.....	$39.62	.....	$40.83	.....

‡ As reported by W. P. Snyder & Co.

STOCK QUOTATIONS

N. Y. EXCH.† Sept. 25	
Alaska Gold M.	3¼
Alaska Juneau	2
Am.Sm.&Ref.,com.	77
Am. Sm. & Ref., pf.	103¾
Am. Sm. Sec., pf., A.	90¼
Am. Zinc	‡15
Am. Zinc, pf.	‡46½
Anaconda	68½
Batopilas Min.	1
Bethlehem Steel	82
Butte & Superior	26½
Butte Cop. & Zinc	9¼
Cerro de Pasco	34¼
Chile Cop.	15½
Chino	40
Colo.Fuel & Iron	46¼
Crucible Steel	65
Crucible Steel, pf.	‡88½
Dome Mines	19
Federal M. & S.	‡11¼
Federal M. & S., pf.	40¼
Great Nor., ore ctf.	31
Greene Cananea	45¼
Gulf States Steel	79½
Homestake	‡74
Inspiration Con.	54¼
International Nickel	30
Kennecott	34¼
Lackawanna Steel	82
Mexican Petrol.	106¼
Miami Copper	27
Nat'l Lead, com.	‡57¼
National Lead, pf.	‡101¼
Nev. Consol.	20¼
Ontario Min.	7
Ray Con.	23¼
Republic I.&S.,com.	91¼
Republic I. & S., pf.	99¼
Sloss-Sheffield	60
Tennessee C. & C.	17
U. S. Steel, com.	111¼
U. S. Steel, pf.	110¼
Utah Copper	82
Va. Iron C. & C.	‡71

BOSTON CURB* Sept. 23	
Alaska Mines Corp.	‡.12
Boston Ely	.80
Boston & Mont.	.43
Butte & Lon'n Dev.	.15
Calaveras	1
Chief Con.	3¼
Contact	.15
Corbin	.10
Cortes	.10
Crown Reserve	.15
Crystal Cop.	.49
Eagle & Blue Bell	2
First Nat. Cop.	1¼
Houghton Copper	.50
Intermountain	‡.05
Iron Cap	.19
Mexican Metals	.30
Mines of America	.90
Mojave Tungsten	.09
Nat. Zinc & Lead	.15
Nevada-Douglas	.40
New Baltic	1
New Cornelia	16¼
Oneco	.20
Pacific Mines	‡.35
Rex Cons.	.05
Yukon Gold	.90

SAN FRAN.* Sept. 25	
Alta	.02
Andes	.03
Best & Belcher	.01
Caledonia	.03
Challenge Con.	.04
Confidence	.10
Con. Virginia	.14
Gould & Curry	.01
Hale & Norcross	.03
Jacket-Cr. Pt.	.06
Mexican	.06
Occidental	.40
Ophir	.01
Overman	.01
Savage	‡.02
Sierra Nevada	.09
Union Con.	.25
Utah Con.	.01
Belmont	‡2.00
Jim Butler	.49
MacNamara	.23
Midway	.06
Mont.-Tonopah	.13
North Star	.03
Rescue Eula	.08
West End Con.	1.07½
Atlanta	.02
Booth	.03
Comb. Frac	‡.02
Florence	.10
Jumbo Extension	.09
Kewanas	.02
Nevada Hills	.02
Nevada Packard	.22
Round Mountain	.15
Silver Pick	.03
White Caps	.13
Big Jim	‡.75
United Eastern	3.50

COLO. SPRINGS* Sept. 25	
Cresson Con.	4.75
Doctor Jack Pot	.03½
Elkton Con.	.04
El Paso	.10
Gold Sovereign	‡.02
Golden Cycle	1.64
Granite	.18
Isabella	.04
Mary McKinney	.07
Portland	.82
United Gold M.	.10
Vindicator	.36

BOSTON EXCH.* Sept. 24	
Adventure	.60
Ahmeek	.75
Algomah	‡.15
Allouez	49
Ariz. Com., ctfs.	15½
Arnold	.20
Bingham Mines	9¼
Bonanza	.16
Butte-Balaklava	.25
Calumet & Ariz.	66½
Calumet & Hecla	445
Centennial	12
Copper Range	46
Daly West	2½
Davis-Daly	5
East Butte	9¼
Franklin	4
Granby	81
Hancock	5½
Hedley	‡12
Helvetia	.25
Indiana	.60
Isle Royale	25
Keweenaw	1
Lake	4½
La Salle	2½
Mason Valley	3¼
Mass	3½
Mayflower	2½
Michigan	2
Mohawk	55½
New Arcadian	1½
New Idria	14¼
North Butte	13½
North Lake	.50
Oilbway	.75
Old Dominion	39
Osceola	50½
Quincy	55
St. Mary's M. L.	48
Santa Fe	.65
Seneca	10½
Shannon	3¼
Shattuck-Ariz.	14¼
So. Lake	.50
So. Utah	.12
Superior	4½
Superior & Bost.	3¼
Trinity	2½
Tuolumne	.93
U. S. Smelting	42
U. S. Smelt'g, pf.	43
Utah Apex	1½
Utah Con.	9¼
Utah Metal	1½
Victoria	2½
Winona	1
Wolverine	23
Wyandot	.55

N. Y. CURB† Sept. 25	
Big Ledge	.87½
Butte & N. Y.	‡.75
Butte Detroit	.07
Caledonia	.48
Calumet & Jerome	1⅛
Can. Cop. Corpn.	‡1⅛
Carlisle	‡2
Cashboy	‡.04
Con. Ariz. Sm.	‡1½
Con. Coppermines	5½
Emma Con.	.01½
Goldfield Con.	‡.20
Goldfield Merger	.02
Greenmonster	‡⅛
Hecla Min.	4¼
Howe Sound	‡4
Jerome Verde	⅛
Louisiana	‡⅛
Magma	32
Majestic	‡.15
Marsh	.03½
McKinley-Dar-Sa.	‡.44
Milford	‡.75
Mother Lode	.34
Nixon Nevada	‡.36
Ohio Cop.	⅛
Rawley	‡2½
Ray Hercules	4½
Richmond	‡.56
Rochester Mines	.34
St. Joseph Lead	‡.14
Standard S. L.	.25
Stewart	‡14
Success	.11½
Tonopah	2½
Tonopah Ex.	1½
Tribullion	‡.12½
Troy Arizona	.12
United Cop.	⅛
United Verde Ext.	‡37
United Zinc	‡8
Utica Mines	‡.08

TORONTO* Sept. 25	
Adanac	.05
Bailey	.03
Beaver Con.	.28
Chambers Ferland	.09
Coniagas	2.00
Hargraves	.02
Kerr Lake	5.87½
La Rose	.50
Min. Corp. of Can.	2.25
Nipissing	9.00
Peterson Lake	.07
Temiskaming	.28
Wettlaufer-Lor	.03
Davidson	‡.30
Dome Exten.	.13
Dome Lake	.10
Hollinger	4.62½
McIntyre	1.37½
Newray	.10
Porcu. Crown	.14
Teck-Hughes	.20
Vipond	.10
West Dome	.08

* Bid prices. †Closing prices. ‡ Last quotations.